YEAR 2003 ANNUAL FISHERIES REPORT

EVERGLADES NATIONAL PARK

August, 2004

Jason Osborne, Thomas W. Schmidt, and John Kalafarski

South Florida Natural Resources Center
Everglades National Park
40001 State Road 9336
Homestead, FL 33034

WEB SITE- http://www.nps.gov/ever/current/report.htm

INTRODUCTION

National Park Service (NPS) management policies state that recreational fishing is permitted in parks when it is authorized by federal law or is not specifically prohibited, and is in accordance with applicable federal/state laws and regulations. However, the NPS may restrict fishing activities whenever necessary to achieve management objectives. NPS goals and management objectives are based on the preservation of diversity and ecological integrity of fish populations. When harvest is permitted, in no case should it be allowed to reduce the reproductive potential of the population or to radically alter its natural (unfished) age structure. Fishing activity and harvest of gamefish from Everglades National Park (ENP) have been monitored nearly continuously since 1958. The objectives of marine fisheries monitoring in the Park are to estimate the Catch Per Unit Effort (CPUE, also known as catch rate), relative abundance, age structure, total harvest, and boating and fishing activity.

This monitoring program was initiated because of concern over increased fishing pressure resulting from the construction of a highway, marina facilities, and an access canal to Whitewater Bay in 1958. The first ten years of the Park's fishery monitoring program (1958-1969) were conducted through the University of Miami's Institute of Marine Science and were directed at evaluating only the sport (recreational) fishery. Under this program, measures of catch and CPUE (catch rates) were made only from those fishermen operating out of Flamingo. This data covered a large part of the fishery, but missed two other major areas: eastern Florida Bay and the lower 10,000 Islands.

In 1965, a permitting system was established for commercial fishermen operating within ENP. These fisheries included commercial hook & line (primarily spotted seatrout), netting (mullet and pompano) stone crab trapping, and professional guides. Until 1972, this catch data consisted of monthly total harvest, by species, for each fisherman. The harvest reports did not include any measure of fishing effort or specific area of harvest, so it was not possible to monitor populations by ecosystem or management unit, or to evaluate the degree to which fishermen complied with reporting requirements.

In 1972, the NPS expanded the monitoring program to include daily trip ticket reports from commercial permit holders and developed censusing techniques to evaluate total parkwide sport fishing and commercial effort. The primary emphasis of the expanded monitoring was to improve the precision of the catch rate and total fishing effort estimates for both sport (recreational) and commercial fisheries (Davis 1979a). In 1974, fish size data was added to the information recorded and, in 1980, Chokoloskee-Everglades City (lower 10,000 Islands) boat ramps were added on a routine basis.

In 1978, a second detailed account of the Park's marine fishery database was completed in response to recreational fishermen and guide complaints of declining stocks. The results of this assessment were incorporated into a document for public review concerning alternative fishery

management options for ENP (Davis 1979b). This assessment summarized the estimated total harvest of fish from ENP waters by species, by area, and fishermen type from 1973-1977; however, no detailed analysis of catch rate response to changes in effort or to environmental factors were made. Insufficient fish length data also were available in 1979 to evaluate such important parameters as age structure, mortality rates, and response to changes in fishing effort and harvest.

During the late 1980's, Virtual Population Analysis (VPA) cohort stock assessments for the Park's major fish species, based on a 10-year collection (1974-1984) of 40,000 fish length measurements, were conducted. VPA's are statistical models which use catch data to produce relative estimates of how many fish of a given species exist or how many of a particular age class are surviving to become spawners. Park stock assessments included total mortality estimates, age structure, and a yield-per-recruit analysis for the three most commonly caught gamefish species: spotted seatrout, red drum, and gray snapper (Tilmant et al. 1986, Rutherford et al. 1989a, 1989b). This review concluded that environmental factors might explain as much of the variability in fish abundance as does fishing pressure.

Stock assessments, status and trend reports, and fisheries presentations for the period 1994-2002 are briefly discussed in previous (1995-2002) annual fisheries reports. For years 2002 and 2003, project personnel participated in several scientific and management meetings, and stock evaluations/assessments. Emphasis was on the status of snook populations, and the development of proposed new rules for the west coast of Florida based partially on the analysis of the Park's fisheries database. Other on-going snook issues included causes of short-term changes in catch rates of snook and snook/red drum differences in catch rates associated with live bait and artificial bait use in ENP coastal waters. Although no significant differences in catch rates were found for snook/red drum in the bait analysis, the ENP did provide support for snook bag reductions and seasonal closures as proposed by FFWCC (Florida Fish and Wildlife Conservation Commission).

ENP port samplers are currently involved in a collaborative effort with one of FFWCC's fishery biologists, Ron Taylor, to assess the condition of snook stocks throughout South Florida. Park personnel interview fishermen to determine the size (either within the slot size of 26" to 34", under the slot, or over the slot) of the snook that they released (or harvested) and take pertinent biological samples (otoliths) to determine the age of each individual fish. The information used in the "catch and release" practices of recreational anglers helps to investigate the size of fish that remain within the ENP snook stock. Gonads of female snook harvested by fishermen are sampled to determine the reproductive status of each fish. Fin clips of harvested snook were also sampled to determine if there are genetic differences between fish located in the eastern and western portions of ENP. The samples are collected and stored in alcohol or formalin and send to St. Petersburg, FL for analysis. Only preliminary results are available at this time, however at the conclusion of a 3-year period, a publication will be forthcoming.

An analysis of the marine fisheries database was undertaken as part of a request from National Marine Fisheries Service (NMFS) Protected Fisheries Division, (St Petersburg) to document the abundance of the smalltooth sawfish and goliath grouper in South Florida. It was found that the vicinity of the Park's coastal waters serves as the last U.S. stronghold for smalltooth sawfish. In April 2003, the smalltooth sawfish was the first fully marine finfish species to be added to the Endangered Species Act. Smalltooth sawfish visual and acoustical tagging studies have been implemented in ENP waters to monitor their movement, distribution, and abundance. The ENP database will be used to monitor the recovery, abundance, and distribution of smalltooth sawfish in South Florida. One of the co-authors, Tom Schmidt, was appointed to be the NPS representative on the Sawfish Recovery Team (SRT). The ENP database will also be used to monitor the recovery, abundance, and distribution of goliath grouper, another protected marine fish, in South Florida. One of the co-authors of this publication produced a paper entitled "Standardized catch rates of juvenile Goliath Grouper, *Epinephelus itajara*, from the Everglades National Park Creel Survey, 1973-1999" (Cass-Calay and Schmidt, 2003). Data from the Park's creel database was used to calculate a catch: effort series as an index of abundance of the sub-adult segment of the goliath grouper stock (Cass-Calay and Schmidt, 2003). In October 2003, this paper was presented at the 56th Gulf and Caribbean Fisheries Institute meeting at Tortola, British Virgin Islands.

Continuing conceptual model development for various coastal CERP (Comprehensive Everglades Restoration Project) projects (Biscayne Bay Coastal Wetlands Project) identified interactions between ecosystem dynamics and higher trophic levels in Florida Bay and adjacent marine waters, focusing, in part, on adult spotted seatrout and snook catch rates. Various Federal/State interagency meeting participants identified draft ecological performance measures as indicators of ecosystem restoration. Snook and spotted seatrout CPUE are under development as performance measures for both the Florida Bay/Florida Keys and Southwest Florida Feasibility studies and, along with other recreationally important species, will be considered in the CERP evaluation /decision making process.

A health advisory remains in effect for five species of marine fish found in northern Florida Bay. The average mercury level of spotted seatrout, gafftopsail catfish, crevalle jack, ladyfish, and bluefish is in excess of the state limit for human consumption.

This is the ninth fisheries report produced since 1990. Due to severe personnel shortages, only basic data collection activities were maintained from 1991-1994 by port samplers at Flamingo and Everglades City. This report includes a description of the fishery, relative abundance, and average size of the four major catch species in 2003, as well as comparisons with previous years. In addition, estimated total catch/harvest, effort, and boating activity are included, as well as environmental effects on CPUE from 1985-2003.

METHODS

Methods (data collection/recording format) employed to obtain sport fishing monitoring and boating activity data in ENP have been previously presented by Higman (1967), Davis and Thue (1979) and Tilmant et al. (1986), and are briefly discussed below.

Recreational fishermen are interviewed at boat launch sites (Flamingo and Chokoloskee/Everglades City) upon completion of their trip every weekend. Data recorded includes area fished (see Figure 1), fish kept and released, effort (number of angler multiplied by hours fishing), species preference, angler residence, and fish lengths. Professional guides are required to obtain an annual permit from the Park and report their monthly catch and effort on a per trip basis via logbooks supplied with the permit. Prior to 1980, reporting was voluntary. Reporting compliance of the guide fishermen is determined from recorded field observations by park rangers and by port samplers at the boat launch sites. Since the elimination of commercial fishing in ENP in 1985, only recreational guided and non-guided recreational anglers are permitted to fish within ENP waters.

Daily estimates of the total number of fishing boats operating in Park waters were made by regressing the daily counts of empty trailers at Flamingo against a known number of boats fishing the same day. Aerial surveys were used to determine the correlation of boat trailers at the Flamingo launch ramp to the total number and distribution of boats within the Park. Over 243 flights were conducted using randomly selected weekdays and weekends stratified by month for three sample periods (July 1972 to May 1975; October 1977 to October 1978; and October 1983 to October 1984). Highly significant linear relationships between the number of trailers at Flamingo and total boats observed in the Park were obtained during each sampling period. The accuracy of the aerial observers was about 94% (152 known patrol boats on the water, 143 sighted). No significant differences were found among the regression statistics for the three survey periods and therefore all the data were pooled to strengthen the expansion estimates ($r=0.84$, $N=243$, $p<0.01$) (Tilmant et al. 1986). There was no significant difference in the boat count/trailer count regression between weekdays and weekends. The percentage of recreational boats actually fishing was determined from boater interviews.

Flamingo is by far the greatest single access point to Florida Bay and has been used by 50-60% of the total anglers. During 1972-1974 and 1981-1984, additional interviews were obtained at ramp sites along the Florida Keys. However, no significant differences were found in the catch composition or catch rate of these anglers when compared to those anglers fishing the same areas interviewed at Flamingo (Tilmant et al. 1986). Catch data from Area 6 is almost entirely from Chokoloskee/Everglades City interviews.

Estimates of total recreational catch and harvest of individual fish species for the non-guided fishery were determined by applying the recorded mean catch (or harvest) of that species per successful trip to the estimated total number of fishing trips successful for that species. The

estimated total number of recreational fishing trips for a species was determined by applying the proportion of recreational boats contacted by interviewers, that were successful for the species, to the estimated total recreational boats determined by the ramp boat-trailer count. Statistical differences were found between Everglades City (Area 6) and Flamingo (Areas 1-5); therefore, total estimated catch and harvest computations were made separately for the Everglades City and Florida Bay regions and then added to obtain parkwide estimates (Tilmant et al. 1986).

Estimates of total catch and harvest for the guide fishery were obtained by dividing the reported catch and harvest (separately) by the percentage of guides that were in compliance with sending in fishing reports on days guides were known to be guiding. Not all guides reported their catch as required; therefore, a reporting compliance adjustment was necessary. The estimate of reporting compliance as determined through independent field observations of fishing activities was about 43% in 2003.

The mean annual catch rates (CPUE) and harvest rates (HPUE) were calculated after Malvestuto (1983). Only those anglers successful in catching a species were used to calculate a catch or harvest rate to avoid bias in the possible change in the proportion of effort applicable to a species each year.

Statistical procedures used in previous years included tests for the assumptions of normality (Kolmogorov-Smirnov test) and homogeneity (Bartlett's Box F). When these assumptions were met, a parametric one-way ANOVA or t-test was used to test differences in catch rate by fishery and area. If conditions of homogeneity or normality were not met after transformations, a non-parametric Kruskal-Wallis test was used instead of the ANOVA. After significance was determined ($p<0.05$), a Student-Newman-Keuls test or Dunn's multiple comparison test was used to identify particular differences.

Fish lengths taken from recreational (non-guided) anglers in 2003 were analyzed to determine if there were differences among fishing areas and seasons. A parametric one-way ANOVA (F) was used to test differences in mean harvest length by area and season. The degrees of freedom (df) for the analysis are written as a subscript after F, where the first number describes the df of the model (or between groups) and the second number describes the df for the error (or within groups). If a significant difference was detected for an ANOVA ($p<0.05$), a Tukey's Multiple Comparison test was used to test for particular differences.

RESULTS

All of the non-guided angler catch data for Florida Bay and the immediately adjacent waters (Cape Sable, Whitewater Bay, and Shark River area, hereafter referred to as Florida Bay) have come from interviews conducted at the Flamingo boat ramps. All of the non-guided angler catch data for Everglades City (Lostman's River to the northwestern boundary of the Park near

Chokoloskee) has come from interviews conducted at the Everglades City-Chokoloskee boat ramps and marinas.

During 2003, 2580 boaters were interviewed at Flamingo. About 97% of these boaters were involved in sportfishing activity. Only 4.5% of the anglers did not catch fish.

At Everglades City, 2139 boaters were interviewed in 2003. Over ninety three percent of the boaters interviewed were sportfishing. Only 5.9% of the fishermen did not catch fish.

Description of the Fishery (2003)

Most (84.3%) of the anglers fishing out of Flamingo were South Florida residents (Dade County to Ft. Lauderdale, excluding local residents); 2.0% were local residents (Florida City, Flamingo, and the Florida Keys); 12.5% were Florida residents from the rest of Florida. Only 1.2% of the anglers came from out of state.

Most (80.7%) of the anglers fishing out of Everglades City were Florida residents, excluding South Florida and local residents. South Florida (Dade and Broward counties) accounted for 3.6% of the anglers, while 14.0% were local (Chokoloskee/Everglades City) residents and 1.7% came from out of state.

An estimated 28,878 fishing trips, 68,979 anglers, and 29,864 boats made up the boating and fishing activity in Florida Bay. Of these fishing trips, 8.64% were interviewed at the Flamingo boat ramps. The average trip lasted 7.35 hours with an average fishing time of 6.1 hours and an average of 2.39 anglers on board.

At Everglades City, an estimated 16,699 fishing trips, 38,781 anglers, and 17,860 boats made up the boating and fishing activity. Of these fishing trips, 11.98% were interviewed at the Everglades City/Chokoloskee boat ramps. The average trip lasted 6.88 hours with an average fishing time of 5.5 hours and an average of 2.32 anglers on board.

Most anglers interviewed at Flamingo (71.7%) did not try to catch a specific kind of fish. Red drums were the most popular fish, sought by 9.1% of the fishermen; snook were targeted by 7.5% of the fishermen. The next three species preferred were spotted seatrout (5.2%), tarpon (2.4%), and gray snapper (2.0%). Approximately 47% of the fishing parties interviewed in 2003 reported catching spotted seatrout (Figure 4). The next four species most commonly caught were gray snapper (43.4%), red drum (32.1%), snook (27.6%), and tarpon (5.3%).

Most anglers interviewed at Everglades City (70.1%) did not try to catch any particular species of fish. Snook was by far the most popular fish, sought by 21.6% of the fishermen. The next four species preferred by anglers were spotted seatrout (3.5%), red drum (2.3%), tarpon (1.0%), and gray snapper (0.3%). More than 46.4% of the fishing parties interviewed in 2003 reported catching snook in Area 6 (Figure 4a). The next four species most commonly caught

were spotted seatrout (33.9%), red drum (30.9%), gray snapper (26.0%), and tarpon (4.4%).

There were an estimated total of 45,577 fishing trips in ENP waters during 2003. This represents a decrease from 46,171 fishing trips estimated in 2002. The overall trend in recreational fishing trips since 1972 shows high values in 1973-75, with lows in 1979-80, and a rebound in the mid-80's to a high value in 1989 (Figure 2). The decline in 1992 is attributed to the impacts of Hurricane Andrew, when the ENP was closed from September through December. There was an increasing trend from 1993 until 1997, which had the second highest number of fishing trips recorded in ENP. The estimated number of fishing trips generally remained the same between 1998 and 2000, but showed a large increase in 2001 (Figure 2). The estimated number of fishing trips in 2002 and 2003 has declined from the all-time high in 2001 (Figure 2). The recreational fishing effort (total estimated angler-hours) has followed this same general trend from 1972-2003 as well (Figure 3).

Relative Abundance (CPUE and HPUE)

Catch rate is a function of the number of fish caught per unit of time (or effort) expended. The number of fish caught for each hour of fishing is used as an index of the abundance of the fish. The 2003 mean catch rate (CPUE) and harvest rates (HPUE) for the 11 major species of the recreational (non-guided) fishery in Florida Bay (Areas 1-5), Everglades City (Area 6), and all of ENP (Areas 1-6) are given in Table 1. Table 2 gives the mean catch and harvest rates of the six major species caught by guided anglers in Florida Bay (Areas 1-5), Everglades City (Area 6), and all of ENP (Areas 1-6). The relationships of 2003 non-guided catch and harvest rates to past years are presented in Figures 5-6 for the four major gamefish species (snook, red drum, spotted seatrout, and gray snapper). The relationships of recreationally guided catch and harvest rates in 2003 to past years are presented in Figures 7-8 for six of the major gamefish species (snook, red drum, spotted seatrout, gray snapper, tarpon, and bonefish).

Estimated Total Catch and Harvest

The catches of the interviewed recreational anglers and the reported catches of the guided fishermen are only samples of the total number of fish caught in ENP. Catch rates calculated from interviews are multiplied by the estimated total number of boats fishing for a particular species to yield estimates of total non-guided catch and harvest. For the guided fishery, the total number of fish reported caught/harvested is divided by the percent guide compliance to yield the estimated total catch/harvest by species. The 2003 estimated total non-guided and guided catch/harvest (# of fish) is shown in Table 3. The relationships of 2003 estimated total catch and harvest to previous years are shown in Figures 9, 9a, 9b, and 10.

Recent Trends (Florida Bay, Parkwide, and Everglades City as noted)

Overall, 2003 annual guided and non-guided successful catch rates for snook, red drum, spotted seatrout, and gray snapper were nearly as high or higher than recent years (Figures 5, 6, 7, 8, 9, 9a, 9b, and 10). Annual harvest rates for the four major species had been decreasing steadily since the middle to late 1980's, but seem to be holding steady in recent years. In

general, catch rates may be used as an index of abundance and are directly related to environmental factors, but they are not directly affected by fishing regulations, while harvest rates most certainly are.

Snook

The popularity of snook has increased dramatically in recent years. Nearly 41% of licensed anglers in Florida have snook stamps (Muller and Murphy, 1999). The percentage of fishing parties catching snook in Florida Bay increased from 9% in 1985 to over 27% in 1994, but suffered a slight decrease through 2000 (Figure 4). The percentage of fishing parties catching snook increased to an all-time high of 28.1% in 2001, slightly decreased to 25.6% in 2002, and increased to 27.6% in 2003. The percentage of fishing parties catching snook in Everglades City (Area 6) since 1995 decreased to a low of 36% in 1998 but rebounded to 44.9% in 2001 (Figure 4a). In 2002, 40.6% of these anglers were catching snook, while in 2003 this number increased to an all-time high of 46.4%. The January 1, 2002 regulation change (which decreased the bag limit to 1 snook per person per day and indefinitely closed the month of May for anglers fishing in ENP and Monroe county) might have *indirectly* affected the percentage of fishing parties that reported catching snook. Since more slot-sized fish were released during the closed seasons in 2002, there would presumably be more fish to be caught in 2003.

Catch (CPUE)/Harvest (HPUE) Rates:

Harvest rates for both recreational and guide fishermen in ENP have been relatively stable since 1980 (Figures 5, 6 and 7). Harvest rates in Florida Bay dramatically decreased in 2002 to an all time low of 0.08 snook/angler-hour primarily due to new regulations only allowing anglers to harvest one snook/person/day and a new closed season for snook beginning May 1 instead of June1 through August 31 (Figure 5). In 2003, this harvest rate increased slightly to 0.0919. Harvest rates for all of ENP (Areas 1-6) also were at all-time lows in 2002 (Figure 6), while harvest rates for guided anglers were relatively unaffected by the new regulations (Figure7). It is important to note that the harvest rates for guided anglers have been making a gradual decline since 1999, with 2003 having the second lowest HPUE for the period of record (0.0919 snook per angler-hour). Catch rates for recreational anglers in ENP (Areas 1-6) were at an all-time high of 0.4524 in 2003, while harvest rates slightly increased from the all-time low 2002 levels (Figure 6). Guide catch rates have been relatively stable since 1996 (Figure 7). Catch rates for non-guided anglers in Florida Bay have shown a cyclical trend every eight years (Figure 5). From 1980 there were catch rates that steadily increased to an all-time high of 0.337 snook per angler-hour in 1984. The catch rate then gradually decreased to 0.171 fish per angler-hour in 1988, only to increase to another high in 1992 of 0.326 fish per angler-hour. Another low was reached in 1997 (0.217 fish per angler-hour), then catch rate increased yet again in 2000 to a value of 0.297 fish per angler-hour. There have been overall slight decreases in catch rates since 2000. According to the trend in snook catch rates seen for the previous 23 years, there should be another year or two of slightly declining catch rates before beginning an upward trend for the next four years, commencing with another peak in 2008.

These trends were corroborated by stock assessments conducted by FMRI (St. Petersburg) using state and federal recreational fishery statistics (Muller and Murphy, 1999). The increases may reflect stock recruitment of small juvenile snook, which were released in prior years because of size restrictions and were recruited to the fishery four years later; that is the time needed for snook to recruit to the Park fishery (Thue et al, 1982). Snook are a relatively non-migratory, inshore species that will make localized movements between estuaries as juveniles and move to nearby offshore areas as adults for spawning. Recruitment may have also been enhanced by increased rainfall and/or runoff.

In a collaborative project with FMRI (Marathon), the monthly mean catch rates from 1985-1998 for each individual area (Areas 1-6 separately) were analyzed using non-parametric trend analysis to detect long-term changes in the catch rate of snook. Snook CPUE (catch rates) showed no significant trends in Area 1 and Area 4; however, there were significant increasing trends in Area 3, Area 5, and Area 6. The cause of the increases is yet to be determined, but changing environmental parameters and fishing effort will be investigated. No analysis was done for Area 2 because of insufficient data.

Estimated Total Catch & Harvest:

Recreational (non-guided) angler estimated total harvest in Florida Bay (Areas 1-5) has remained relatively stable throughout the period of record, despite new bag limit restrictions that began January 1, 2002 (Figure 9). Since more fishermen are targeting the species than ever before, this would indicate that the Florida Bay stocks might have been overfished in the recent past (Muller and Murphy, 1999). On the other hand, an analysis of total catch and harvest for Areas 1-6 (Figure 9a) and Area 6 (Figure 9b) in the most recent years (1998-2003) has shown a general increase (excluding 2002) in total catch and stable numbers in total harvest for snook. In the year that the new regulations were implemented (2002), there were decreases in both total catch and total harvest estimates for Areas 1-6 and Area 6. In 2003, while there were slight increases in total harvest for recreational anglers, total catch for all areas (Areas 1-5, Areas 1-6, and Area 6) showed the largest numbers for the period of record (Figures 9, 9a, and 9b). Estimated total catch for snook in Florida Bay has fluctuated in recent years, with 2001 and 2003 projecting some impressive numbers (25,887 and 27,403 respectively) (Figure 9). Guided anglers' total catch and harvest in Florida Bay had been increasing since 1990, but dropped after all-time highs in 1995 (Figure 10). While the guided total catch estimates have been fluctuating in recent years, the total harvest estimates for guided anglers have been steadily decreasing since 2000. The data for 2003 reflected the lowest estimated total harvest numbers (695 snook) for the period of record (Figure 10). This low estimate could be an indication that more guides are enforcing a “catch and release” policy for all snook, not for just those outside the slot size.

Red Drum

The percentage of fishing parties catching red drum in Florida Bay decreased dramatically from

33% in 1985 to 17% in 1988 when the fishery was closed due to overexploitation (Figure 4). When harvest of red drum was reopened, the percentage of anglers catching the species increased steadily to a 14 year high of 36% in 1997 (Figure 4). While the percentages of anglers catching drum continued to drop to 27.2% in 2000, an upward trend occurred in 2001 and has only slightly decreased for the past two years. The percentage of fishing parties catching red drum in Everglades City (Area 6) was gradually declining between 1995 (a high of 36%) and 2000 (a low of 24.6%), followed by a significant increasing trend for the past 3 years (Figure 4a).

Catch (CPUE)/Harvest (HPUE) Rates:

Red drum harvest rates for recreational fishermen in Florida Bay (Figures 5) and in all of ENP (Figure 6) have remained quite stable beginning in 1989 when bag limits of 1 fish per person/day were imposed. Guide harvest rates in Florida Bay also have been quite stable since the 1988 closure (Figure 7). Increased size limits (12" to 18") and a closed season imposed on the fishery in September 1985 probably accounted for the large declines in harvest rates after 1985; however, the sharp decline during 1985 suggests the possibility of overharvest or poor recruitment (Figures 5 and 7). Recreational non-guided angler catch rates in Florida Bay had been increasing since there was a low of 0.290 fish per angler-hour in 1994 to 0.384 fish per angler-hour in 1998. There was a slight decrease each year since 1998 from 0.370 fish per angler-hour in 1999 to an all-time low of 0.2724 fish per angler-hour in 2002, however 2003 catch rates have recovered (Figure 5). Since the fishery recovered faster than anticipated, the Florida Marine Fisheries Commission (FMFC) allowed year-round harvesting of red drum in 1996, which may explain the higher catch rates in the late 1990's (Figure 5). Recreational angler catch rates for Everglades City (Area 6) have remained relatively constant since the mid-1990's (Figure 6). It should be noted that guide catch rates have shown a steady declining trend in the years between 1985 and 1995 (Figure 7). In 1996 and 1997 there were significant increases in guide catch rates, followed by decreases in 1998 and 1999. Similarly, in 2000 and 2001 there were increases in guide catch rates, followed by declines in 2002 and 2003, which reflected an all-time low of 0.369 fish per angler-hour (Figure 7). Concurrently, guide harvest rates have also remained fairly constant since 1998 (Figure 7) and have, in general, since 1989.

In a collaborative project with FMRI (Marathon), the monthly mean catch rates from 1985-1998 for each individual area (Areas 1-6 separately) were analyzed using non-parametric trend analysis to detect long-term changes in the catch rate of red drum. There were no significant long-term trends in red drum CPUE (catch rates) in any of the areas.

Estimated Total Catch & Harvest:

Annual estimated total catch data from non-guided fishermen suggests that red drum catches in Florida Bay had been steadily increasing from 1988 until an all-time high of an estimated 45979 fish caught in 1997 (Figure 9). Since 1997, there were large decreases in total catch for 1998, 1999 and 2000 (Figure 9). There has been a general increasing trend since 2000, with 2001

total catch estimates being the second highest during the period of record (43,656 fish). The 2002 total catch declined considerably to an estimated 31,328 fish, however rebounded to 35,741 fish in 2003. The trend for estimated total harvest in Florida Bay for the period of 1998-2003 tends to show a 3 year cyclical trend, beginning with high harvest rates for the first year, followed by two years of declining harvest rates (Figure 9). Total estimated harvest of red drum in Florida Bay by guided fishermen has also shown a slow, but steady increasing trend from 1990 to 1998, and has a slight downward trend since 1998, with 2003 (1651 fish) having the lowest estimates since 1993 (Figure 10). The estimated total catch for guided anglers increased from 1990 until 1997 and has gradually declined since 1997, with 2003 (10,767 fish) having the lowest estimates since 1991 (Figure 10). An analysis of the total catch of red drum by non-guided anglers in all of ENP (Areas 1-6) showed a gradual decrease in 1998-2000, followed by a significant increase in 2001 (Figure 9a). There was a significant decrease in 2002, however total catch in 2003 rebounded to the second highest level for the period of record. The harvest rates follow these trends as well, but remain relatively stable. For Everglades City (Area 6), similar trends in the estimated total catch and total harvest of red drum between 1998 and 2003 were seen as well (Figure 9b).

Spotted Seatrout

The percentage of fishing parties interviewed at Flamingo (Areas 1-5) catching spotted seatrout declined slightly from 1985-1989, but increased sharply to a 19 year high in 1992 of almost 61% (Figure 4). Since then, the percentage of anglers catching seatrout declined to an all-time low in 1996 of 39% (Figure 4). There was an increasing trend since 1996, with seatrout being caught by over 58% of the recreational anglers in 2000. Since 2000 there have been dramatic decreases in the percentage of parties catching seatrout (Figure 4). The percentage of fishing parties interviewed at Everglades City (Area 6) that were catching spotted seatrout since 1995 has not shown a significant trend and ranges between 30% (1995) and 42.9% (2000) (Figure 4a). As with anglers fishing out of Flamingo, there has been a decreasing trend for parties catching seatrout out of Everglades City since 2000 (Figure 4a). Fishing regulations may have affected angler strategy, as the declining trend in seatrout fishing is associated with increases in red drum and snook fishing. Anglers may have switched their target preferences to the latter two species when their successful catches increased after the regulation changes.

Catch (CPUE)/Harvest (HPUE) Rates:

Recreational angler harvest rates for spotted seatrout had been holding steady since 1990 in Florida Bay (Figure 5) and in all of ENP (Figure 6) however there has been a decreasing trend in the past three years. Guide harvest rates, on the other hand, have been gradually decreasing since 1982; yet, guide catch rates have been fluctuating over the same time period (Figure 7). The catch rate for recreational anglers in Florida Bay has also fluctuated throughout the period of record, however significant decreases in catch rates in 2001 (0.8395 fish/angler-hour) and 2002 (a 24-year low of 0.6835 fish/angler-hour) have been noted (Figure 5). Due to these low catch rates, fisheries personnel will be reviewing this in further detail to see if there is a concern for making any adjustments in the closed season, bag limit, or size restrictions. The catch rate

has only slightly increased in 2003 to 0.7003 fish/angler-hour. The catch rate of seatrout in all of ENP (Areas 1-6) has been relatively stable since 1990, however there has been a decreasing trend since 2000, ending with a 14-year low of 0.6166 fish/angler-hour in 2003 (Figure 6). Harvest rate for spotted seatrout in Areas 1-6 was also at a 14-year low of 0.2305 fish/angler-hour in 2003. The lack of increase in harvest rate associated with an increase in catch rate may be due to state regulations imposed on the fishery in 1989 which raised the legal size limit from 12" to 14", and then for the South Florida populations to 15" in 1996 (Figure 5). These regulations were meant to reduce harvest to achieve the FMFC's spawning potential ratio (SPR) objective of 35%. The SPR is the ratio of the spawning stock biomass of the exploited fish population to the spawning stock biomass of the same population in an unfished condition.

In a collaborative project with FMRI (Marathon), the monthly mean catch rates from 1985-1998 for each individual area (Areas 1-6 separately) were analyzed using non-parametric trend analysis to detect long-term changes in the catch rate of spotted seatrout. Seatrout CPUE (catch rates) showed no significant trends in Area 1 and Area 3; however, there were significant declining trends in Area 4, Area 5, and Area 6. The cause of these declines is yet to be determined, but changing environmental parameters and fishing effort will be investigated. No analysis was done for Area 2 because of insufficient data.

Estimated Total Catch & Harvest:

Annual estimated total harvest data from non-guided fishermen in Florida Bay suggests that seatrout total harvest decreased steadily from 1989 to 1996 (Figure 9). Since 1997, the estimated number of fish harvested has remained relatively stable, however, in 2003, there was an all-time low of only 18,217 fish (Figure 9). The estimated total catch of seatrout in Florida Bay has been fluctuating for the period of record. There were increasing total catch estimates in the late 1990's (Figure 9). In 2000, total catch estimates were at an all-time high of 172,966 fish, but these impressive numbers were followed by a dramatic decline in the last three years, ending with the second lowest total catch for the period of record in 2003 (98,944 fish) (Figure 9). The estimated total catch and harvest for all of ENP (Areas1-6) and Everglades City (Area 6) and between 1998 and 2003 have shown gradual increases through 2000, while there have been significant decreases for the past three years (Figures 9a & 9b). Estimated total harvest from guided recreational anglers in Florida Bay had been very stable from 1990-1995, but experienced an all-time low in 1996 (Figure 10). Since 1996, seatrout total harvest rebounded to 16,002 fish in 2000, but has decreased in the past three years. The estimated total catch of seatrout by guided fishermen had shown an increasing trend since 1990 (excluding 1996), until an all-time high of 103,098 fish in 2000 (Figure 10). However, there has been a general downward trend since 2000, with 2003 total catch estimate (44,366 fish) being the lowest it has been since the 1996 all-time low (Figure 10).

Gray Snapper

The percentage of fishing parties reporting catches of gray snapper in Florida Bay has remained relatively stable from 1985-2003 (Figure 4). The large decline seen in 1991 was probably due

to new regulations that established the minimum size at 10" with a bag limit of five fish per person. The percentage of anglers catching gray snapper increased from 29% in 1997 to nearly 38% in 1999. In 2000 there was an all-time low of 27.9% of fishing parties catching gray snapper, but there has been an increasing trend since 2000 to the third highest level (43.4% of fishing parties catching gray snapper) in 2003 (Figure 4). The percentages of fishing parties interviewed at Everglades City (Area 6) that were catching gray snapper have remained very stable since 1995, but they have been on an increasing trend since 2001 (Figure 4a). In 2003, there was an all-time high of 26% of fishing parties interviewed at Everglades City that were catching gray snapper.

Catch (CPUE)/Harvest (HPUE) Rates:

In general, harvest rates for recreational non-guided and guided anglers in Florida Bay (Areas 1-5) for gray snapper had shown steady declines from 1980 until the mid-1990's, however have leveled off and remained relatively stable since (Figures 5 and 7). Catch rates for both guided and non-guided anglers have been fluctuating through the period of record, however catch rates have been on an upward trend for the last three or four years (Figures 5, 6, and 7). After a steady decline from 1992 to 1998, the catch rate for recreational non-guided anglers jumped to 0.892 fish per angler-hour in Florida Bay in 1999 (Figure 5). During 1988-1992, the increase in catch rate, and a lack of an increase in harvest rate, may reflect good recruitment of small juvenile fish to the stock. Perhaps the large increase in catch rate in 1999 was also related to good recruitment. In 2003, the harvest rate in Florida Bay was the highest it has been for 11 years (0.3617 fish/angler-hour) (Figure 5). Similarly, the harvest rates for the entire Park (Areas 1-6) and for guided anglers in Florida Bay were at the highest they have been for 11 and 13 years, respectively (Figures 6 and 7).

In a collaborative project with FMRI (Marathon), the monthly mean catch rates from 1985-1998 for each individual area (Areas 1-6 separately) were analyzed using non-parametric trend analysis to detect long-term changes in the catch rate of gray snapper. There were no significant long-term trends in gray snapper CPUE (catch rates) in any of the areas.

Estimated Total Catch & Harvest:

During the mid-late 1990's, the annual guided and non-guided estimated total catch and total harvest for gray snapper in Florida Bay dropped as low or lower than anytime during previous records (Figures 9 and 10). The decreasing total harvest estimates in the early to mid-1990's is probably due to regulations imposed on the fishery in 1988 and 1990 when the legal minimum size was increased from 6" to 8" and then to 10" with a daily bag limit of 5 gray snapper per person. Total harvest estimates since 1996, in general, have remained relatively stable in Florida Bay, however there has been on an upward trend for the past three or four years (Figures 9 and 10), with 2003 estimates being the highest since 1990 (for non-guided anglers) and 1995 (for guided anglers). Estimated total catch for gray snapper resembles a cyclical 3-year trend since 1990 (Figure 9). This is no surprise since gray snapper in Florida Bay take approximately 3-4 years to be recruited into the fishery. While the estimated catch for non-

guided anglers in Florida Bay experienced large increases from 1997-1999, there was a marked decline in 2000 (Figure 9). Since 2000, there has been a dramatic increasing trend in total catch, culminating with the third highest level (121,679 fish) for the period of record in 2003 (Figure 9). In 2003, there was a significant increase in estimated total harvest of gray snapper in Florida Bay, which was the highest estimates (31,536 fish) there have been since 1990 (Figure 9). Estimated total catch and harvest throughout all ENP (Areas 1-6) gradually decreased from 1998 to 2000. There has been a general increasing trend since 2000, with 2003 showing the highest levels for both catch and harvest rates (142,044 fish and 31,858 fish, respectively) for the period of record (Figure 9a). The estimated total catch and harvest of gray snapper in Everglades City (Area 6) showed a marked decrease from 1998 to 1999, leveled off from 2000-2002, and have decreased considerably in 2003 (Figure 9b). Estimated total harvest of gray snapper in Everglades City for 2003 were extremely low, so we will be doing further analysis with the data to determine the causes for these estimates. There might be a problem with the way that the estimates are figured, so these estimates for total catch and harvest are only very rough estimates. We will continue to work on perfecting these estimates in future annual reports.

Tarpon & Bonefish

The professional guide fishery is largely directed at a few highly prized gamefish species. Two of these species, tarpon and bonefish, are of little food value and are not sought by the majority of the non-guided anglers. They are the trophy species of the guide fishery. Since harvest of tarpon occurs for the purposes of "catching and releasing" the fish or having it professionally mounted by a taxidermist, catch rate is more indicative of the stock than harvest rate.

The catch rate of tarpon rebounded in 1983, from a low in 1982, but experienced a slow decline in the mid-1980's reaching another low in 1987 (Figure 8). The CPUE (catch rates) of tarpon increased to an all-time high of 0.254 fish per angler-hour in 1995 and then leveled off around a somewhat lower CPUE of approximately 0.20 fish per angler-hour in the following years (Figure 8). There have not been any reported tarpon harvested in Florida Bay for the past 3 years, so harvest rates have been non-existent (Figure 8).

Like tarpon, bonefish are not harvested unless the angler desires to mount the catch. Bonefish catch rates for guided anglers were on a steady decline in the early 1980's, followed by a steady increase through the late 1980's (Figure 8). Guide catch rates for bonefish reached an all-time high in 1994 only to decline again for the period of 1995-2000 (excluding 1997). For the time period of 1990 until 2001, catch rates seemed to be on a 4-year cyclical trend (Figure 8). Catch rates for bonefish have remained relatively stable for the past five years (1999-2003), but reached an all-time low of 0.2308 fish/angler-hour in 2000 (Figure 8). Nearly all bonefish are caught in Area 2 and are released when caught; therefore, it is highly unlikely that fishing mortality has played any significant role in determining bonefish stock abundance. The annual estimated total catch of tarpon and bonefish for guided anglers in 2003 is given in Table 3.

Fish Lengths (2003)

Snook

A comparison of mean lengths of snook harvested by non-guided anglers in Areas 1, 2, 3, 4, 5, and 6 showed that there was not a significant difference in mean lengths among the six areas in 2003 ($F_{5, 405}$ =0.257, p=0.936) (Figure 11). The lengths for Areas 1-5 were pooled together to determine if there was a difference in the lengths of snook harvested in Florida Bay (Areas 1-5) versus Everglades City (Area 6). For 2003, there was no difference in mean snook length between Florida Bay and Everglades City ($F_{1, 409}$ =0.213, p=0.644) (Figure 12).

A parkwide seasonal comparison of snook lengths for 2003 also showed that there was not a significant difference among the four seasons ($F_{3, 407}$ =2.088, p=0.101) (Figure 13). In 2003, a comparison of snook lengths from Florida Bay only (Areas 1-5) showed that there was not a significant difference in the length of harvested fish among the four seasons ($F_{3, 267}$ =1.356, p=0.257) (Figure 14). We also found that there was no significant difference ($F_{3, 136}$=1.479, p=0.223) in the lengths of harvested snook among the four seasons in Area 6 (Everglades City) (Figure 15).

Red Drum

There was a significant difference in the mean lengths of red drum harvested among the six areas of ENP during 2003 ($F_{5, 595}$=9.467, p<0.0001) (Figure 11). On average, using a Tukey's Multiple Comparison test, red drum harvested from Area 1 were significantly longer than the red drum taken from Area 4, Area 5, and Area 6 (p=0.026, p=0.001, and p<0.0001, respectively) (Figure 11). The lengths for Areas 1-5 were pooled together to determine if there was a difference in the lengths of red drum harvested in Florida Bay (Areas 1-5) versus Everglades City (Area 6). In 2003, there was a significant difference in the lengths of red drum harvested in Florida Bay versus Everglades City ($F_{1, 599}$ =27.651, p<0.0001) (Figure 12). Using Tukey's Multiple Comparison test, red drum harvested in Areas 1-5 were significantly longer than those from Area 6 (p<0.0001) (Figure 12).

A seasonal comparison of red drum lengths parkwide (Areas 1-6) showed that there was not a significant difference in the lengths of red drum in 2003 ($F_{3, 597}$ =0.517, p=0.671) (Figure 13). The lengths of red drum harvested in Florida Bay only (Areas 1-5) did not show significant seasonal differences either ($F_{3, 329}$ =0.572, p=0.634) (Figure 14). Similarly, red drum harvested in Everglades City (Area 6) did not show significant differences among seasons ($F_{3, 264}$ =0.543, p=0.653) (Figure 15).

Spotted Seatrout

In 2003, there were significant differences in the mean lengths of harvested spotted seatrout among the six areas of ENP ($F_{5, 1036}$ =4.252, p=0.001) (Figure 11). Using a Tukey's Multiple Comparison test, harvested spotted seatrout in Area 3 were significantly longer than those from

Area 5 and Area 6 (p=0.002 and p=0.013, respectively) (Figure 11). When the lengths for Areas 1-5 were pooled together to determine if there was a difference in the lengths of spotted seatrout harvested in Florida Bay (Areas 1-5) versus Everglades City (Area 6) during 2003, there was not a significant difference ($F_{1, 1040}$=2.855, p=0.091) (Figure 12).

There was a significant difference in the mean lengths of spotted seatrout harvested parkwide (Areas 1-6) among the four seasons in 2003 ($F_{1, 1038}$ =4.285, p=0.005) (Figure 13). Using Tukey's Multiple Comparison test, trout harvested in the fall (October-December) were significantly shorter than those harvested in winter (January-March) or spring (April-June) (Figure 13). This is not a surprise, since seatrout have a closed season in November and December; therefore the only lengths that were used for this "fall" analysis are from October. A seasonal comparison of spotted seatrout harvested only in Florida Bay (Areas 1-5) showed that there was not a significant difference in the lengths of seatrout harvested among the four seasons of the year ($F_{3, 370}$ =2.504, p=0.059) (Figure 14). In contrast, there was a significant difference found in the lengths of spotted seatrout harvested in Everglades City (Area 6) during the four seasons of 2003 ($F_{3, 664}$ =3.726, p=0.011) (Figure 15). Using Tukey's Multiple Comparison test, seatrout harvested in the summer (July-September) were significantly shorter than those harvested in winter or spring (Figure 15).

Gray Snapper

In 2003, there was a significant difference in the lengths of harvested gray snapper among the six areas of ENP ($F_{5, 940}$=33.593, p<0.0001) (Figure 11). The gray snapper that were harvested in Area 2 were significantly longer than ones harvested from Areas 1, 3, 4, 5, or 6 (p<0.0001, p=0.004, p<0.0001, p<0.0001, and p<0.0001, respectively) (Figure 11). In addition, gray snapper that were harvested in Area 6 were significantly shorter than those harvested in Areas 1, 2, 3, 4, and 5 (p=0.001, p<0.0001, p<0.0001, p=0.002, and p<0.0001, respectively) (Figure 11). The lengths for Areas 1-5 were pooled together to determine if there was a difference in the lengths of gray snapper harvested in Florida Bay versus Everglades City (Area 6). Indeed, gray snapper harvested from Areas 1-5 were significantly larger than those harvested in Area 6 ($F_{1, 944}$ =64.45, p<0.0001) (Figure 12).

There were significant differences in the size of gray snappers harvested parkwide (Areas 1-6) among the four seasons in 2003 ($F_{3, 942}$ =4.372, p=0.005) (Figure 13). Using Tukey's Multiple Comparison test, snapper harvested in the winter were significantly longer than those harvested in fall (p=0.002) (Figure 13). Similarly, gray snapper lengths in Florida Bay only (Areas 1-5) were significantly different among the four seasons ($F_{3, 723}$ =5.508, p<0.001) (Figure 14). Using Tukey's Multiple Comparison test, snappers harvested in the winter were significantly longer than those harvested in the summer or fall (p=0.003 and p=0.001, respectively) (Figure 14). In comparison, harvested gray snapper in Everglades City (Area 6) showed no significant seasonal differences in lengths during 2003 ($F_{3, 215}$ =0.474, p=0.701) (Figure 15).

Environmental Relationships

Catch rates are directly related to environmental factors such as rainfall, water level, and salinity. The catch rates for recreational (non-guided) fishermen were correlated with rainfall, water level, and salinity from 1985-2003 (Figures 16-19). Total annual rainfall from 1985-2003 was compiled and averaged from five stations within or near ENP (Flamingo, Royal Palm, Everglades City, Tamiami Ranger Station (Forty Mile Bend), and Tavernier. Butternut Key has replaced Tavernier since 1997). Water level data from 1985-2003 was obtained from well P-37 in western Taylor Slough. Salinity data from 1985-2003 was obtained from three stations in northern Florida Bay (Butternut Key, Taylor River, and Trout Cove).

Snook

The declines in snook stocks from 1985-1988 and from 1993-1999 may have been due to low rainfall and water levels in the upper marsh regions. There was not a significant correlation between water levels recorded and catch rates from 1985-2003 ($r=0.275$, $N=19$, $p=0.255$); this same result was obtained last year as well when 1985-2002 was analyzed. Although, no statistically significant correlation was found, the trends seen in Figure 16 suggest that a period of generally high salinity ($r=-0.172$, $N=19$, $p=0.481$) leads to a decline in the catch rate (or abundance) of snook. Field studies on snook habitat have shown that the greatest number of juveniles are consistently found in shallow, well protected, back-water areas of estuaries that are influenced by freshwater runoff (Fore and Schmidt 1973; McMichael et al. 1987). In addition, no significant correlation was found between rainfall and snook catch rates ($r=0.146$, $N=19$, $p=0.551$).

Red Drum

The reduced abundance of red drum during the late 1980's may have been due to a combination of prior intense fishing pressure and increased rainfall. Previous studies (Higman, 1967) have shown that low rainfall may lead to an increase in the abundance of juvenile red drum. However, no statistically significant relationships were found between red drum catch rates and any of the environmental variables from 1985-2003. Similarly, there were no significant correlations last year when data from 1985-2002 was analyzed (Figure 17). There was not a statistically significant relationship between the red drum catch rates and salinities from 1985-2003 ($r=0.387$, $N=19$, $p=0.102$). Red drum CPUE did not have a correlation with rainfall or water levels either ($r=-0.345$, $N=19$, $p=0.148$ and $r=-0.243$, $N=19$, $p=0.316$, respectively). Although not significant, the correlations between red drum CPUE and rainfall and water levels were inverse relationships.

Spotted Seatrout

As salinity increased to a high in 1990, seatrout catch rates increased, and as salinities dropped in the proceeding years, 1991-1993, catch rates also decreased (Figure 18). However, there seems to be an inverse relationship between seatrout catch rates and salinities since 1993. There was no statistically significant relationship between the two variables from 1985-2003 ($r=0.284$, $N=19$, $p=0.238$). Rainfall and water levels also had no correlation with seatrout

CPUE (r=-0.142, N=19, p=0.563 and r=-0.201, N=19, p=0.410, respectively). These are the same results as last year when environmental parameters were correlated with CPUE from 1985-2002. However, recent studies have suggested that increased rainfall/water levels improve recruitment through increased growth and survival of larvae and juvenile spotted seatrout (Thayer et al. 1998). Presumably an increase in coastal rainfall (and thus lower salinities) results in an increase in larval recruitment and/or juvenile survival (Rutherford et al. 1989a).

Gray Snapper

Overall (1985-2003), a positive significant (r=0.55, N=19, p=0.015) relationship was found between catch rates of gray snapper and mean annual salinities found in northern Florida Bay (Figure 19), suggesting that periods of high salinity may lead to increased abundance of gray snapper. Average annual water levels recorded at P-37 were significantly inversely related to gray snapper catch rates during the same years (r=-0.588, N=19, p=0.008), indicating that during periods of reduced water levels in the upper Taylor Slough the abundance of gray snapper increased. Rainfall was not significantly correlated with gray snapper catch rates (r=-0.383, N=19, p=0.105). Similar correlation results were obtained last year when data from 1985-2002 was analyzed. This leads to the theory that increases in gray snapper abundance may be related to low yearly rainfall in the ENP area and periods of high salinities in Florida Bay. A series of low rainfall years from 1985-1990 resulted in increased hypersaline conditions in Florida Bay (Figure 19). Rutherford et al. (1983) reported larger fish in areas of higher salinity. Thus, if during low rainfall years, sub-adult fish remain in Florida Bay longer under high salinity conditions, then gray snapper abundance (catch rates) should increase and the snappers would become increasingly available to the angler. During the 1993-1995 period, water levels/rainfall increased, especially from Tropical Storm Gordon in November 1994, resulting in salinity reductions in northern Florida Bay with a notable decrease in gray snapper catch rates (Figure 19).

Effort-Catch Relationships

It is not always sufficient to know if catch rates are declining to determine if a fishery is in trouble. If both total catch and catch rates are in decline, then there is a need to assess the amount of effort being placed on the fishery. In Figure 20, estimated total catch and estimated total effort of the four major species in Florida Bay are correlated to determine if fishing effort impacted the stock.

Snook

Annual fishing effort of recreational anglers catching snook in Florida Bay ranged a low of 26,775 angler-hours in 1985 to an all time high of 130,473 angler-hours in 2003 (Figure 20). The total estimated catch of snook from the recreational non-guided fishery in Florida Bay increased from a low of 6,538 fish in 1986 to another all time high of 27,403 fish in 2003 (Figure 20) representing a 58.7% increase from the number of fish caught in 2000. This

increase was due to the concurrent increase in effort. In 2003, while effort (130,473 angler-hours) placed on the snook stock remained relatively the same as in 2002 (125,847 angler-hours), the total estimated catch increased significantly from 18,841 fish to 27,403 fish (Figure 20). The 2003 increase in estimated catch is a good indication that snook abundance is rising, since more snook were caught per unit effort. With new snook regulation changes allowing only 1 fish/person/day to be harvested in ENP beginning in January of 2002, harvest rates would certainly be affected, however not catch rates necessarily. Despite the total estimated catch for snook in 2002 being relatively low, the 2003 estimates rebounded quite well, indicating that the new snook regulations are doing great things for the snook fishery in Florida Bay. In addition, the annual total estimated catch of snook for the recreational non-guided fishery was highly correlated with the total estimated effort placed on the stock between 1985 and 2003 ($r=0.911$, $N=19$, $p<0.0001$) (Figure 20). Total catch appeared to increase linearly over the entire range of annual effort, suggesting that current catches do not greatly impact the Florida Bay stock and that additional increases in catch may be possible. However, it should be noted again that snook catches decreased dramatically in 1998 and 1999 after five years of good catches and a fairly high annual effort in 1997. During 1998, state regulations were revised to prevent further overfishing by increasing the minimum size from 24" to 26" and prohibiting the possession of snook over 34" while maintaining a two fish bag limit.

Red Drum

The total estimated effort for recreational non-guided fishing for red drum in Florida Bay ranged from a low of 58,093 angler-hours 1988 to an all time high of 159,144 angler-hours in 2001 (Figure 20), which represents an increase over 2.5 times the fishing effort in 1988. Estimated effort dropped in 1998, 1999, and 2000, while the estimated catches of red drum concurrently decreased also. A statistically significant linear relationship ($r=0.677$, $N=19$, $p<0.001$) was found between yearly estimated effort from 1985-2003 and the resultant estimated catch, suggesting that the increase in fishing effort did not greatly impact the catch of red drum in the recreational fishery (Figure 20). It should be noted that red drum catch decreased dramatically in 1999 to 29,678 fish after three years (1996-1998) of very good catches due to high fishing effort. The estimated catch of red drum increased again from 29,180 fish in 2000 to 43,656 fish in 2001. However, since there was more effort in 2001, the estimated total catch of red drum was expected to increase also. It is a special concern that while the effort placed on the red drum stock in 2002 (157,121 angler-hours) remained relatively the same as in 2001 (159,144 angler-hours), the total estimated catch decreased significantly (from 43,656 to 31,328 fish) (Figure 20). This is a cause for concern since this indicates that less red drum were caught per unit effort in 2002. If we compare another year similar to that of the 2002 effort (1997 in this case was 154,227 angler-hours), you'd see that considerably more fish were caught per unit effort in 1997 (45,979 fish) than in 2002 (31,328 fish) (Figure 20). In 2003, both the estimated catch (29,447 fish) and the estimated effort (150,818 angler-hours) decreased from the 2002 numbers (Figure 20).

Spotted Seatrout

The correlation of yearly total estimated effort with estimated total catch was linear and significant ($r=0.701$, $N=19$, $p<0.001$) (Figure 20). Total estimated effort for spotted seatrout ranged from a low of 147,882 angler-hours in 1995 to a record high of 249,199 angler-hours in 2001. In conjunction with the increased effort on spotted seatrout from 2000 to 2001, the estimated total catch decreased by about 10,000 fish. This type of trend indicates that yearly fishing effort may have impacted the fishery. Indeed, the amount of effort in 2002 remained relatively the same as in 2001, however the total estimated catch decreased substantially from 2001 (162,801 fish) to 2002 (136,278 fish) (Figure20). Both total catch and total effort for trout decreased in 2003, however since the effort for this year was at a lower level, the total catch was expected to be lower also. While these numbers represent only a few years of data, the spotted seatrout fishery should be able to rebound. We will closely review this trend in next annual report.

Gray Snapper

Annual estimated total effort for the non-guided gray snapper fishery ranged from a high of 200,889 angler-hours in 2003 to a low of 96,311 angler-hours in 1985 (Figure 20). The yearly estimated total catch of gray snapper was the lowest in 1987 and the highest in 1989 (123,707) (Figure 20). While effort only slightly increased from 138,807 angler-hours in 1998 to 140,705 angler-hours in 1999, the catch increased quite dramatically during the same time span from 77,267 fish in 1998 to 96,641 fish in 1999 (this is the fourth highest value during the period of record). Initially this indicates a good recruitment class in 1999, but the low estimated catch in 2000 suggests the contrary. The low estimated catch of snapper in 2000 is partially due to the lowest estimated effort (109,571 man-hours) since 1987. In 2001-2003, the estimated catch and the annual estimated effort for gray snapper both increased. The annual total estimated catch of gray snapper was linearly correlated with the total estimated effort placed on the fishery between 1985-2003 ($r=0.599$, $N=19$, $p=0.007$), suggesting that the maximum potential catch of gray snapper in Florida Bay has not been reached (Figure 20).

FUTURE WORK/MEETING RESULTS

While the current gamefish monitoring project is evaluating various aspects of catch/harvest rates, total estimated catch/harvest, and fishing/boating activity, additional areas of work are underway or are needed. First, we will be updating in-house and FMRI stock assessments on major gamefish species including snook, red and black drum, goliath grouper, and sheepshead. Secondly, we need to incorporate the fisheries database into the Park's GIS system for spatially oriented ecological applications. Thirdly, we plan on developing a new fishery data management handbook. Lastly, to update the estimated number of boats on the water in ENP, which contribute to the estimated effort and estimated total catch and harvest statistics, aerial surveys are proposed to be completed as the budget permits. In addition, a pilot creel census

program at Dry Tortugas National Park, which began in 2002, continues to be monitored by fisheries personnel and will be the focus of a resource monitoring plan for DRTO.

Several collaborative, ongoing studies are underway with Federal/State fishery resource agencies. In a collaborative effort with the NMFS, SEFC, Miami, FL, the recreational database in ACCESS was provided to fisheries personnel to analyze and synthesize with existing fisheries and environmental databases in order to develop statistical models relating species abundance to environmental conditions and different water management scenarios. The scenarios will incorporate the abundance of goliath grouper and are proposed for smalltooth sawfish.

The National Marine Fisheries Service, Gulf States Marine Fisheries Commission, FMRI, and the NPS (ENP) worked cooperatively to develop the Gulf Charter Boat Survey Research Program. The Program is developing methods for more efficient data collection and more precise estimation of fishing effort by charter (guide) boat anglers. The program consists of two surveys - a telephone survey of charter boat operators and a logbook survey. Surveys began in September 1997 and continued through August 1998. FFWCC field intercept surveys continue to provide information for guided and private anglers to estimate angler catch using the existing NMFS estimates. Guide parties fishing in ENP waters during weekdays have also been interviewed at Chokoloskee to obtain information on their catch and fish measurements.

ACKNOWLEDGMENTS

We appreciate the assistance from the Flamingo Rangers who provided trailer counts and rainfall data. We would like to acknowledge Farada Nagel of the Chief Rangers Office for her help in processing the guide permits. Lastly, we are grateful to Kevin Kotun, hydrologist and George Schardt, hydrological technician at the South Florida Natural Resources Center (SFNRC) at ENP, for providing the 2003 salinity, rainfall, and water level data; and to Darrel Tidwell for coordinating the ORACLE data entry for the gamefish database.

LITERATURE CITED

Cass-Calay, S. L., and T. W. Schmidt. 2003. Standardized catch rates of juvenile Goliath Grouper, Epinephelus itajara, from the Everglades National Park Creel Survey, 1973-1999. SEDAR6-RW-2. Contribution SFD-2003-0016, Sustainable Fisheries Div. SE Fisheries Science Center, National Marine Fisheries Service, Miami, Fla. 17 pp.

Davis, G. E. 1979a. An Assessment of fishery management options in Everglades National Park, Florida. USNPS/SFRC/ P.O. Box 279, Homestead, FL, 33030.

Davis, G. E. 1979b. Changes in the Everglades National Park red drum and spotted seatrout Fisheries, 1958-1978: Fishing pressure and environmental stress on natural cycles. In Porch (ed.) Colloquium on the biology and management of red drum and seatrout, p. 81-87. Gulf States Mar. Fish. Com.

Davis, G. E., and E. B. Thue. 1979. Fishery data management handbook. Rept. T-546. Everglades National Park, SFRC, P. O. Box 279, Homestead, FL. 33030.

Fore, P.L., and T.W. Schmidt. 1973. Biology of juvenile and adult snook, *Centropomus undecimalis*, in the Ten Thousand Islands. Ecosystem Analysis of the Big Cypress Swamp and Estuaries. EPA 904/9-74-002, U.S. EPA, Athens,GA.

Higman, H. B. 1967. Relationships between catch rates of sportfish and environmental conditions in Everglades National Park. Gulf Carib. Fish. Inst.19: 129-140.

Malvestuto, S. P. 1983. Sampling the recreational fishery. IN: L.A. Nielsen and D. L. Johnson (eds). Fishery Techniques. Amer. Fish. Soc., Bethesda, MD. p 397- 419.

McMichael, R. H. Jr., K. M. Peters, and G. Parsons. 1987. Early life history of common snook, *Centropomus undecimalis*, in Tampa Bay, Florida. In: Proc.Third Snook Symposium. 1987. West Palm Beach, FL Florida Department of Natural Resources, Marine Research Lab, St. Petersburg, FL. 11 pp.

Muller, R. G., and M. D. Murphy. 1999. The 1999 stock assessment update of common snook, *Centropomus undecimalis*. Fish and Wildlife Conservation Commission, Florida Marine Research Institute. St. Petersburg, Florida. 50pp.

Rutherford, E. S., E. B. Thue, and D. G. Buker. 1983. Population structure, food habits, and spawning activity of gray snapper, *Lutjanus griseus*, in Everglades National Park. South Florida Research Center, Everglades National Park, Homestead, FL. Report 83/02. 41pp.

Rutherford, E. S., J. T. Tilmant, E. B. Thue, and T. W. Schmidt. 1989a. Fishery harvest and population dynamics of spotted seatrout, *Cynoscion nebulosus*, in Florida Bay and adjacent waters. Bull. Mar. Sci. 44: 108-125.

Rutherford, E. S., J. T. Tilmant, E. B. Thue, and T. W. Schmidt. 1989b. Fishery harvest and population dynamics of gray snapper, *Lutjanus griseus*, in Florida Bay and adjacent waters. Bull. Mar. Sci. 44: 139-154.

Thayer, G. W., A. B. Powell and D. E. Hoss. 1998. Response of larval, juvenile, and small adult fishes to changes in environmental conditions in Florida Bay: a decadal comparison. Proc. Florida Bay Sci. Conf., Miami, FL.

Thue, E.B., E.S. Rutherford, and D.G. Buker. 1982. Age, growth, and mortality of the common snook, *Centropomus undecimalis*, in Everglades National Park, Florida. Report T-683. Homestead, FL, ENP, SFRC. 32pp.

Tilmant, J. T., E. S. Rutherford, R. H. Dawson, and E. B. Thue. 1986. Impacts of gamefish harvest in Everglades National Park. Pro. Conf. Sci. in Nat'l Parks. pp. 75-103.

Table 1. Mean catch/harvest rates (fish per angler-hour) of non-guided recreational anglers in Everglades National Park, 2003.

Non-Guided Anglers (Areas 1-5)				
Species	**CPUE ±95% Conf. Interval**	**HPUE ±95% Conf. Interval**	**Sample Size *** CPUE/HPUE	
Snook	0.2397± 0.0457	0.0919 ± 0.0069	347	220
Red Drum	0.3348 ± 0.0490	0.1027 ± 0.0053	466	431
Spotted Seatrout	0.7003 ± 0.0718	0.2237 ± 0.0167	776	573
Gray Snapper	0.7273 ± 0.0770	0.3617 ± 0.0251	513	602
Tarpon	0.1182 ± 0.0279	N/A	88	0
Black Drum	0.3304 ± 0.0547	0.2299 ± 0.0390	189	148
Sheepshead	0.2976 ± 0.0623	0.1467 ± 0.0293	122	122
Spanish Mackerel	0.2207 ± 0.0676	0.1455 ± 0.0275	60	110
Grouper	0.1695 ± 0.0361	0.4089 ± 0.1753	141	26
Ladyfish	0.4039 ± 0.0490	0.1389 ± 0.0290	508	34
Crevalle Jack	0.4542 ± 0.0458	0.1921 ± 0.0662	810	53
Non-Guided Anglers (Areas 1-6)				
Species	**CPUE ±95% Conf. Interval**	**HPUE ±95% Conf. Interval**	**Sample Size *** CPUE/HPUE	
Snook	0.4524 ± 0.0525	0.1085 ± 0.0113	1,162	394
Red Drum	0.2921 ± 0.0285	0.1087 ± 0.0057	1,025	738
Spotted Seatrout	0.6166 ± 0.0510	0.2305 ± 0.0135	1,381	943
Gray Snapper	0.6935 ± 0.0631	0.3429 ± 0.0227	988	747
Tarpon	0.1326 ± 0.0227	N/A	161	0
Black Drum	0.3038 ± 0.0486	0.2148 ± 0.0352	224	167
Sheepshead	0.3355 ± 0.0486	0.1757 ± 0.0310	260	169
Spanish Mackerel	0.2984 ± 0.0660	0.1936 ± 0.0368	184	193
Grouper	0.2022 ± 0.0469	0.0824 ± 0.0197	399	33
Ladyfish	0.4637 ± 0.0464	0.1996 ± 0.0615	1,196	67
Crevalle Jack	0.3936 ± 0.0274	0.1628 ± 0.0477	1,641	76

Table 1 (cont.)

Non-Guided Anglers (Area 6)				
Species	**CPUE** ±**95% Conf. Interval**	**HPUE** ±**95% Conf. Interval**	**Sample Size *** CPUE/HPUE	
Snook	0.5429 ± 0.0714	0.1294 ± 0.0237	815	174
Red Drum	0.2566 ± 0.0323	0.1170 ± 0.0115	559	307
Spotted Seatrout	0.5092 ± 0.0703	0.2410 ± 0.0226	605	370
Gray Snapper	0.6570 ± 0.1016	0.2644 ± 0.0514	475	145
Tarpon	0.1501 ± 0.0369	N/A	73	0
Black Drum	0.1600 ± 0.0839	0.0972 ± 0.0197	35	19
Sheepshead	0.3690 ± 0.0729	0.2509 ± 0.0783	138	47
Spanish Mackerel	0.3360 ± 0.0918	0.2573 ± 0.0754	124	83
Grouper	0.2200 ± 0.0698	0.1190 ± 0.0747	258	7
Ladyfish	0.5079 ± 0.0720	0.2622 ± 0.1183	688	33
Crevalle Jack	0.3345 ± 0.0300	0.0955 ± 0.0252	831	23

* Number of fishing parties.

Table 2. Mean catch/harvest rates (fish per angler-hour) of recreationally guided anglers in Everglades National Park, 2003.

Guided Anglers (Areas 1-5)				
Species	**CPUE ±95% Conf. Interval**	**HPUE ±95% Conf. Interval**	**Sample Size *** CPUE/HPUE	
Snook	0.2474 ± 0.0165	0.0919 ± 0.0060	1,015	237
Red Drum	0.3690 ± 0.0316	0.1161 ± 0.0066	1,182	405
Spotted Seatrout	1.2676 ± 0.0713	0.3862 ± 0.0232	1,550	514
Gray Snapper	1.8307 ± 0.1616	0.7427 ± 0.0565	692	363
Tarpon	0.1947 ± 0.0136	N/A	678	0
Bonefish	0.2529 ± 0.0450	N/A	136	0
Guided Anglers (Areas 1-6)				
Species	**CPUE ±95% Conf. Interval**	**HPUE ±95% Conf. Interval**	**Sample Size *** CPUE/HPUE	
Snook	0.5862 ± 0.0385	0.1147 ± 0.0056	2,209	594
Red Drum	0.4406 ± 0.0231	0.1333 ± 0.0062	2,129	941
Spotted Seatrout	1.2155 ± 0.0602	0.4473 ± 0.0200	1,770	992
Gray Snapper	1.6206 ± 0.1300	0.6710 ± 0.0476	899	479
Tarpon	0.1892 ± 0.0119	N/A	896	0
Bonefish	0.2529 ± 0.0450	N/A	136	0

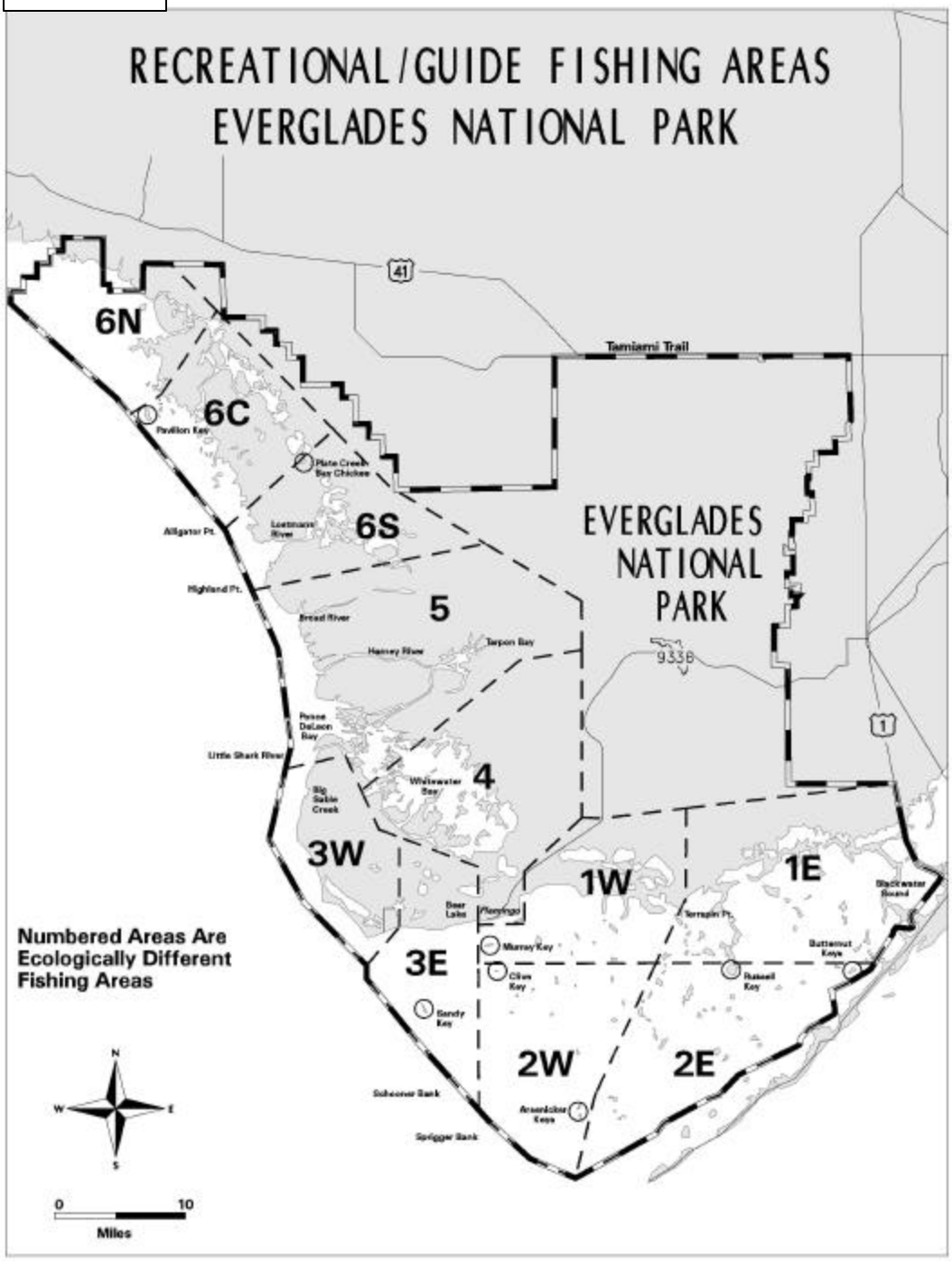
Guided Anglers (Areas 6)				
Species	**CPUE ±95% Conf. Interval**	**HPUE ±95% Conf. Interval**	**Sample Size *** CPUE/HPUE	
Snook	0.8749 ± 0.0657	0.1298 ± 0.0080	1,192	357
Red Drum	0.5299 ± 0.0332	0.1465 ± 0.0096	945	535
Spotted Seatrout	1.4487 ± 0.1147	0.5129 ± 0.0321	662	478
Gray Snapper	0.9184 ± 0.1240	0.4467 ± 0.0724	207	116
Tarpon	0.1719 ± 0.0249	N/A	218	0
Bonefish	N/A	N/A	0	0

* Number of fishing parties.

Table 3. Total estimated catch and harvest by recreational anglers from Everglades National Park, 2003.

Non-Guided Anglers				
	Florida Bay		Florida Bay & Everglades City	
Species	Catch	Harvest	Catch	Harvest
Snook	27,403	2,838	79,907	4,744
Red Drum	35,741	6,294	48,667	9,794
Spotted Seatrout	98,944	18,217	121,640	26,547
Gray Snapper	121,679	31,536	142,044	31,858
Tarpon	2,357	0	3,529	0
Black Drum	11,286	5,911	10,871	5,581
Sheepshead	7,743	2,825	12,482	3,857
Spanish Mackerel	4,824	2,817	8,655	4,790
Grouper	15,128	349	18,174	349
Ladyfish	56,048	665	90,823	1,371
Crevalle Jack	75,561	1,586	97,171	1,634
Other species	99,678	7,528	142,208	11,956
Total	556,392	80,566	776,171	102,481
Guided Anglers				
	Florida Bay		Florida Bay & Everglades City	
Species	Catch	Harvest	Catch	Harvest
Snook	6,717	695	32,471	1,921
Red Drum	10,767	1,651	22,334	3,916
Spotted Seatrout	44,366	6,774	63,558	13,837
Gray Snapper	22,494	6,647	26,149	8,021
Tarpon	3,136	0	4,024	0
Bonefish	543	0	543	0
Other Species	48,134	6,107	67,155	9,016
Total	136,156	21,875	216,234	36,712

Figure 1.


RECREATIONAL/GUIDE FISHING AREAS
EVERGLADES NATIONAL PARK
41
Tamiami Trail
6N
6C
6S
5
4
3W
1W
1E
3E
2W
2E
EVERGLADES
NATIONAL
PARK
9336
1
Pavilion Key
Alligator Pt.
Highland Pt.
Bread River
Tarpon Bay
Little Shark River
Whitewater Bay
Big Sable Creek
Terrapin Pt.
Buttonwood Keys
Murrey Key
Clive Key
Russell Key
Sandy Key
Arsenicker Keys
Sprigger Bank
Numbered Areas Are
Ecologically Different
Fishing Areas
N
W
E
S
0
10
Miles

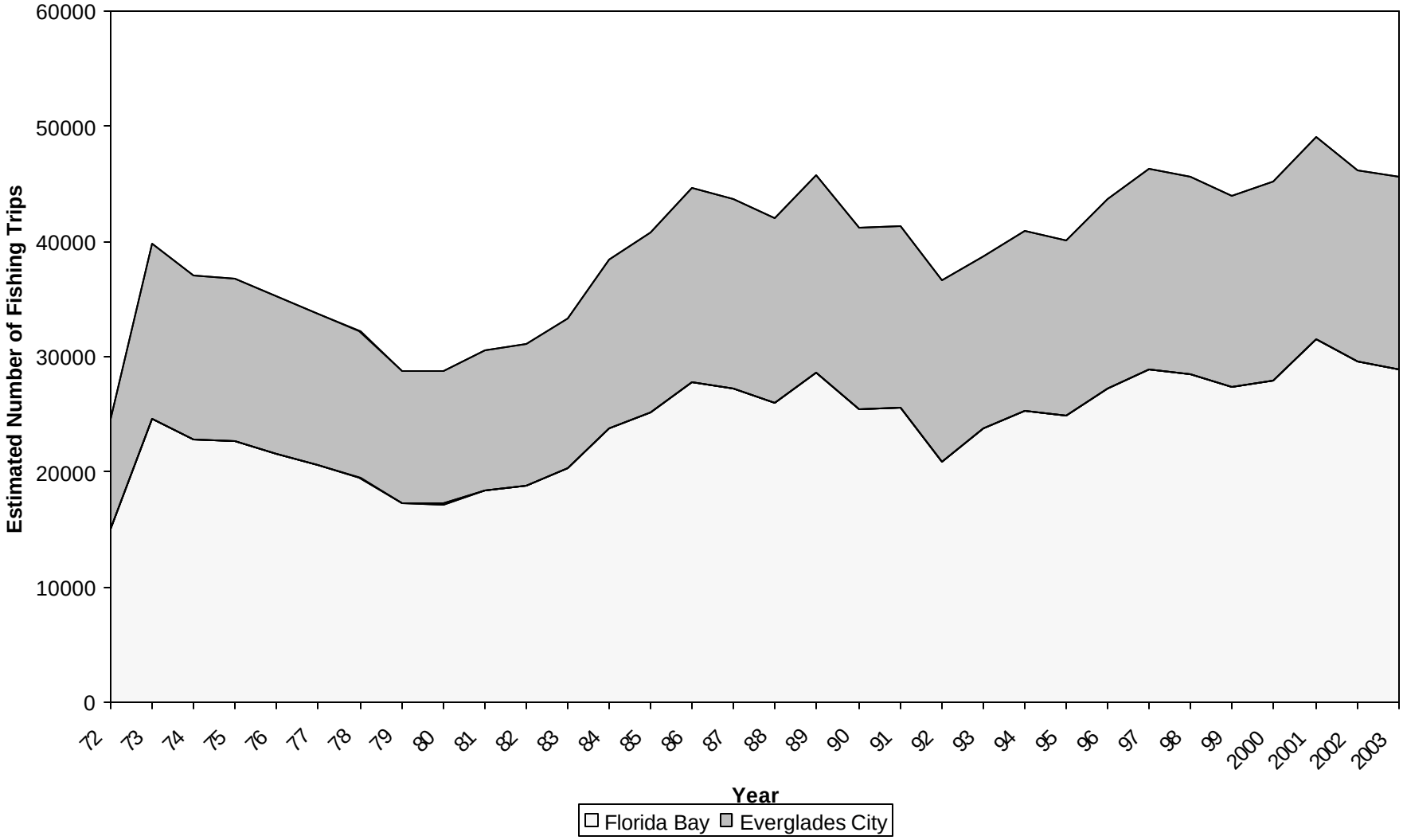


Figure 2. Estimated number of non-guided fishing trips within Everglades National Park, 1972-2003.

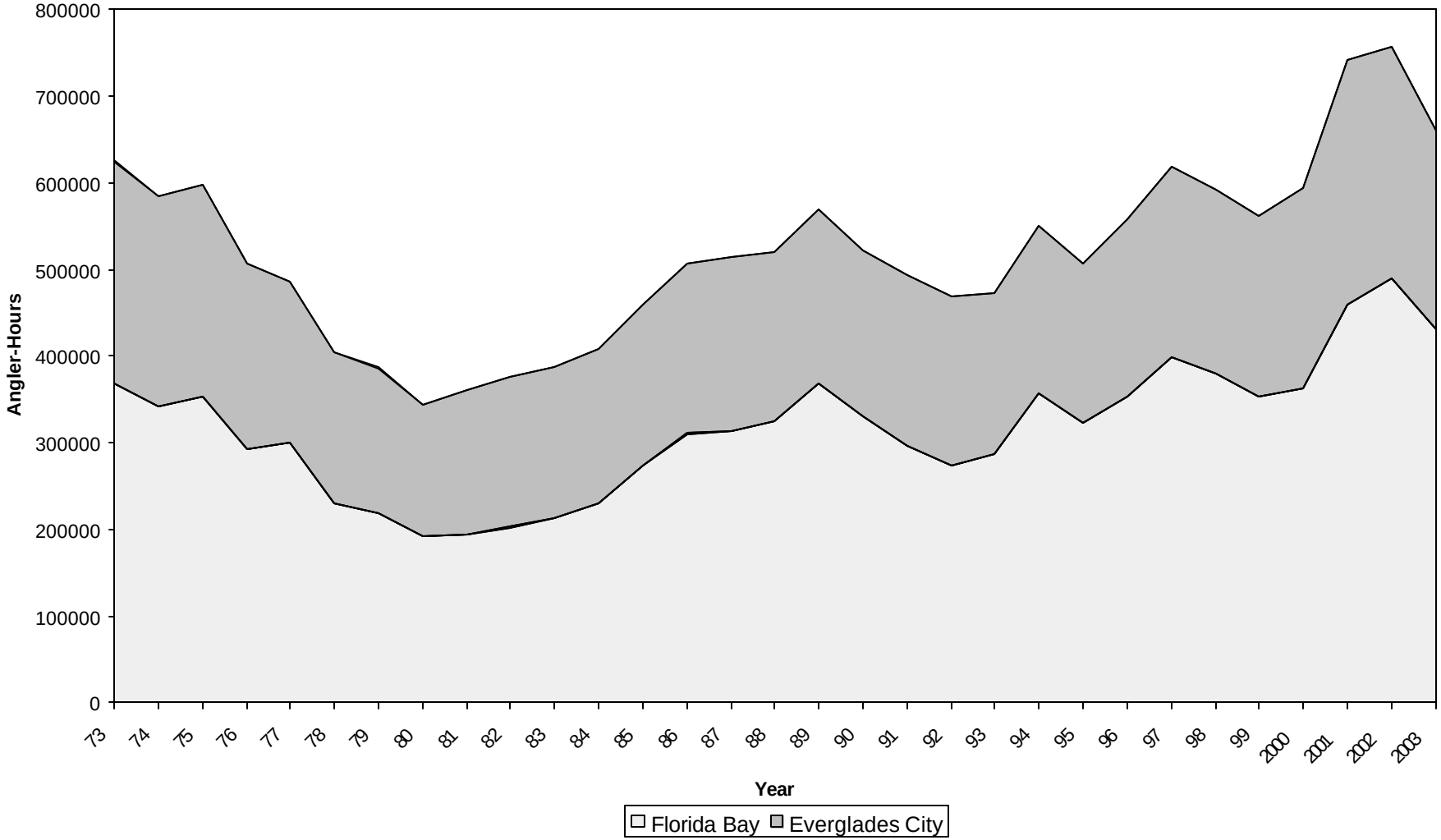


Figure 3. Estimated total effort (angler-hours) of non-guided fishermen within Everglades National Park, 1973-2003.

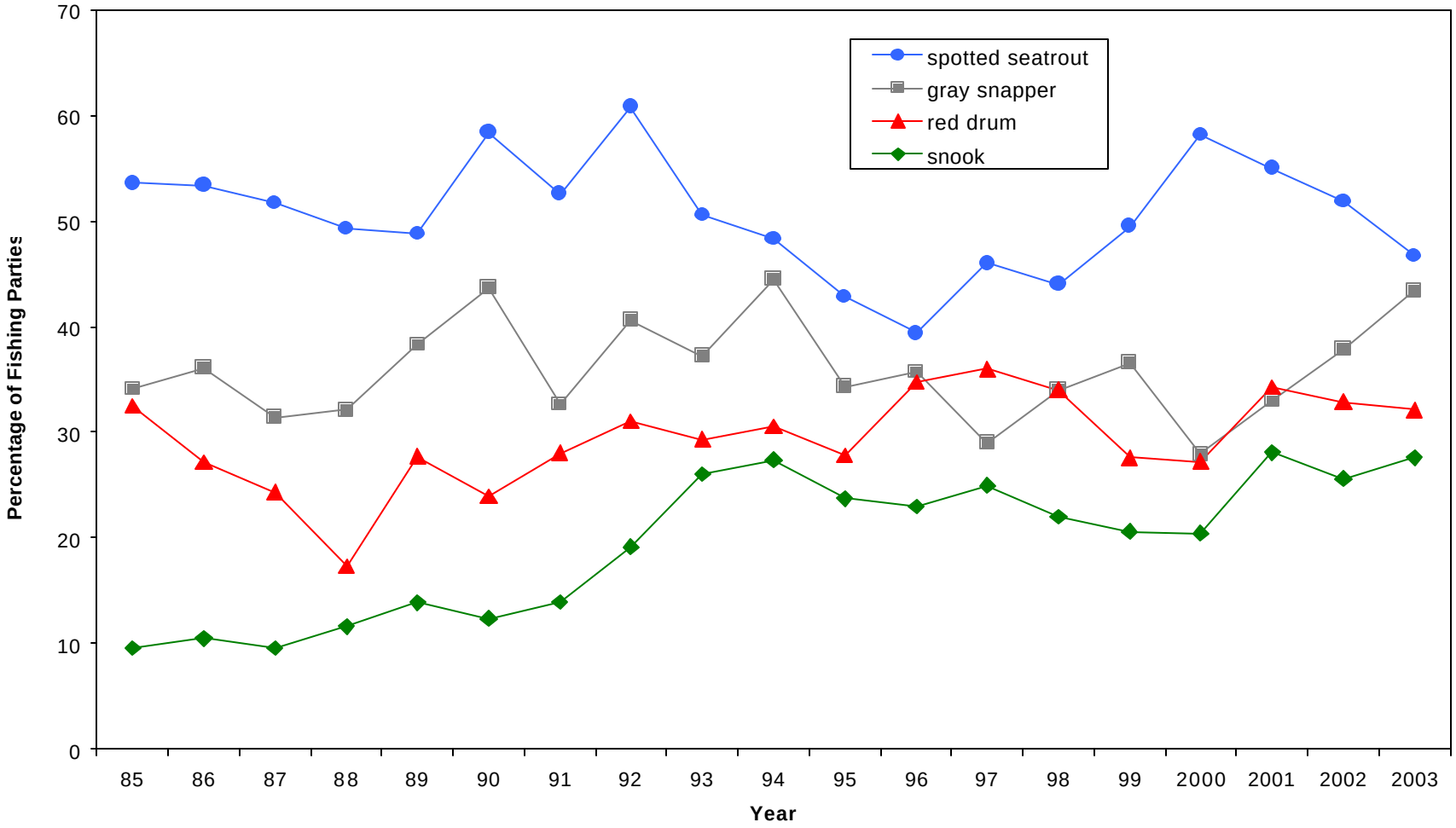


Figure 4. Percentage of fishing parties interviewed at Flamingo (Areas 1 to 5) catching spotted seatrout, gray snapper, red drum, and snook from 1985-2003.

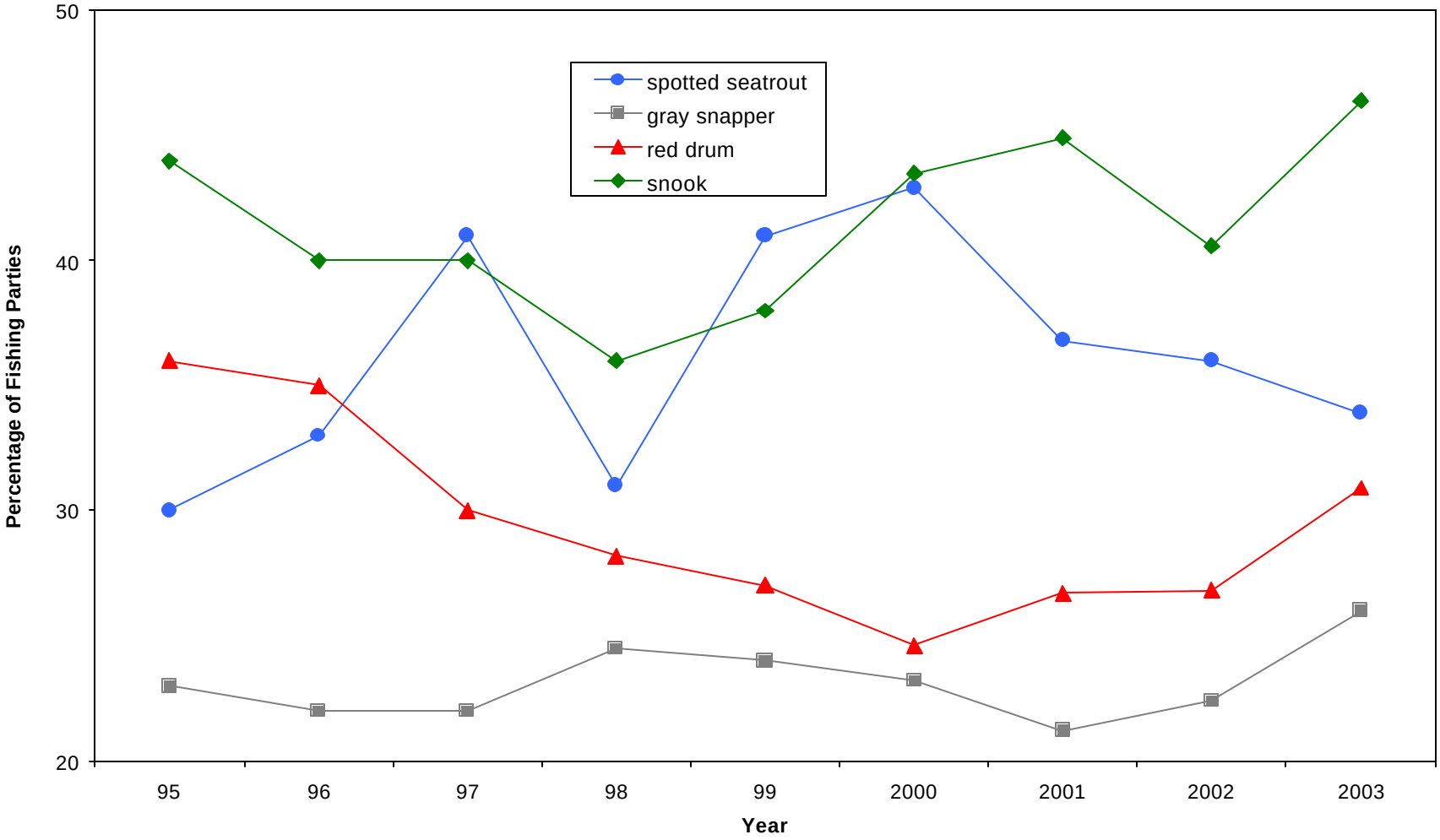


Figure 4a. Percentage of fishing parties interviewed at Everglades City (Area 6) catching spotted seatrout, gray snapper, red drum, and snook from 1995-2003.

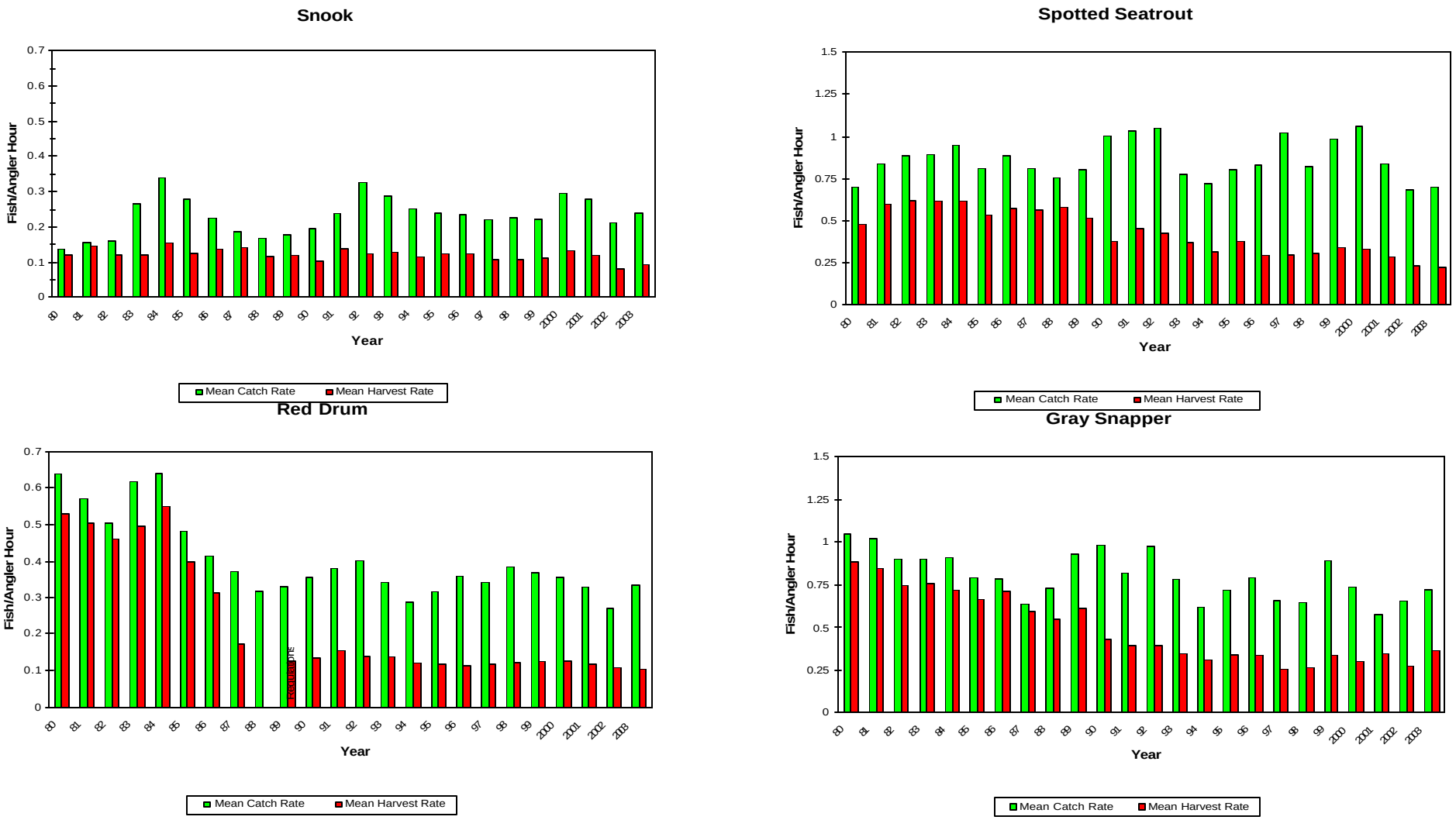


Figure 5. Recreational non-guided (sport) catch and harvest rates for the four major species of gamefish in Florida Bay, Everglades National Park (Areas 1-5), 1980-2003.

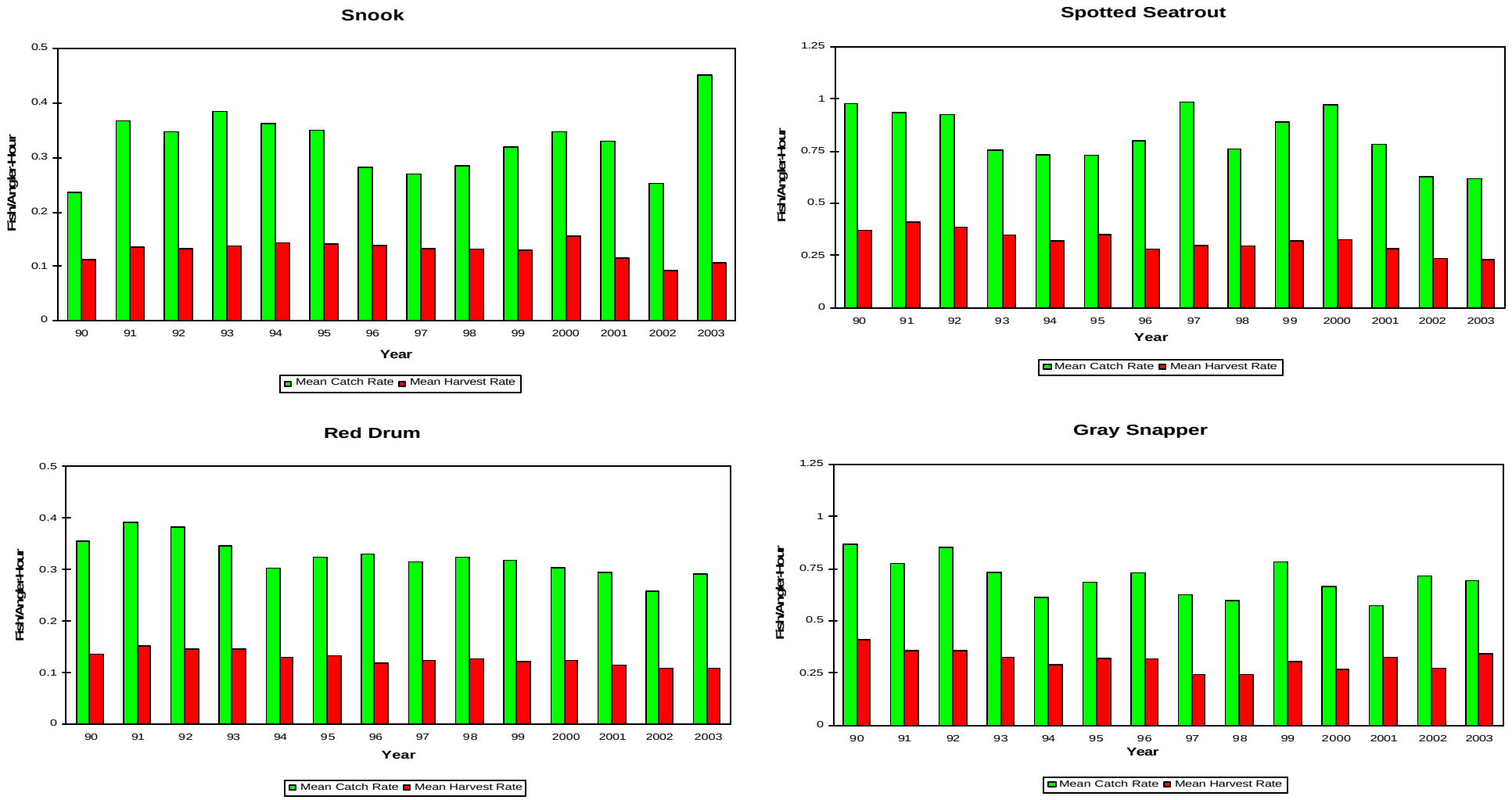


Figure 6. Recreational non-guided (sport) catch and harvest rates for the four major species of gamefish in Everglades National Park (Areas 1-6), 1990-2003.

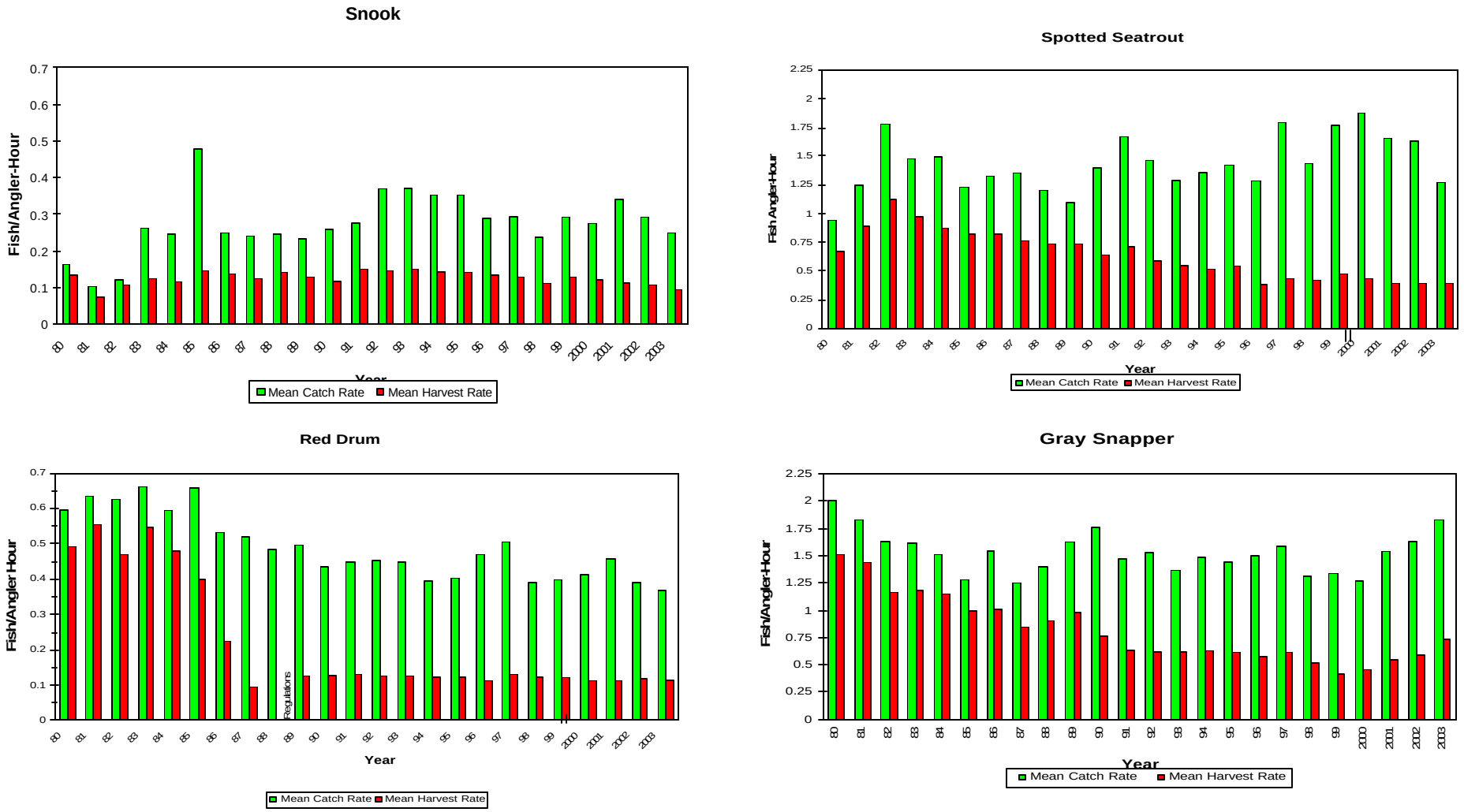


Figure 7. Recreational guide catch/harvest rates for four major sportfish species in Florida Bay (Areas 1-5), 1980-2003.

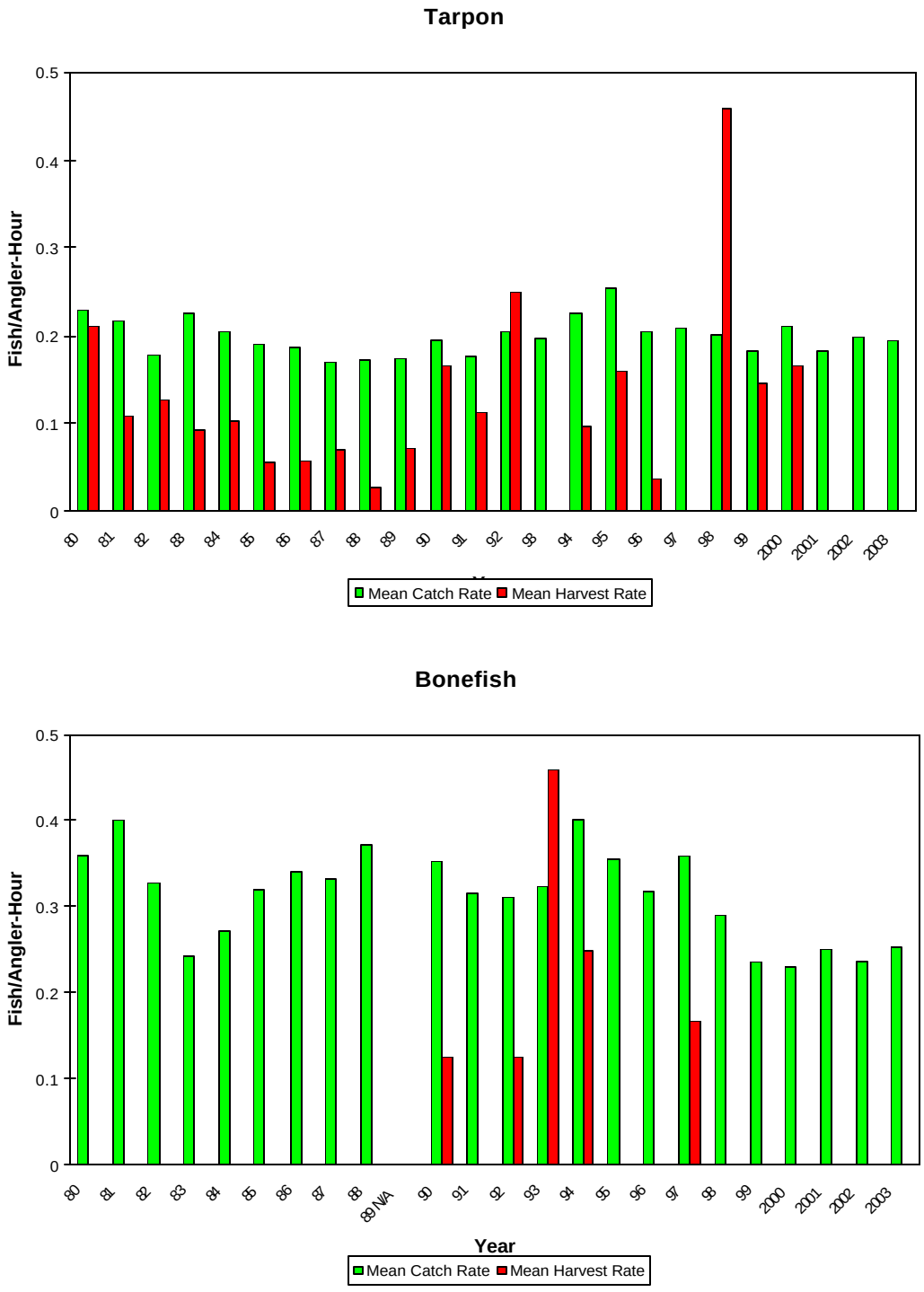


Figure 8. Recreational guide catch and harvest rates for tarpon and bonefish in Florida Bay (Areas 1-5) 1980-2003.

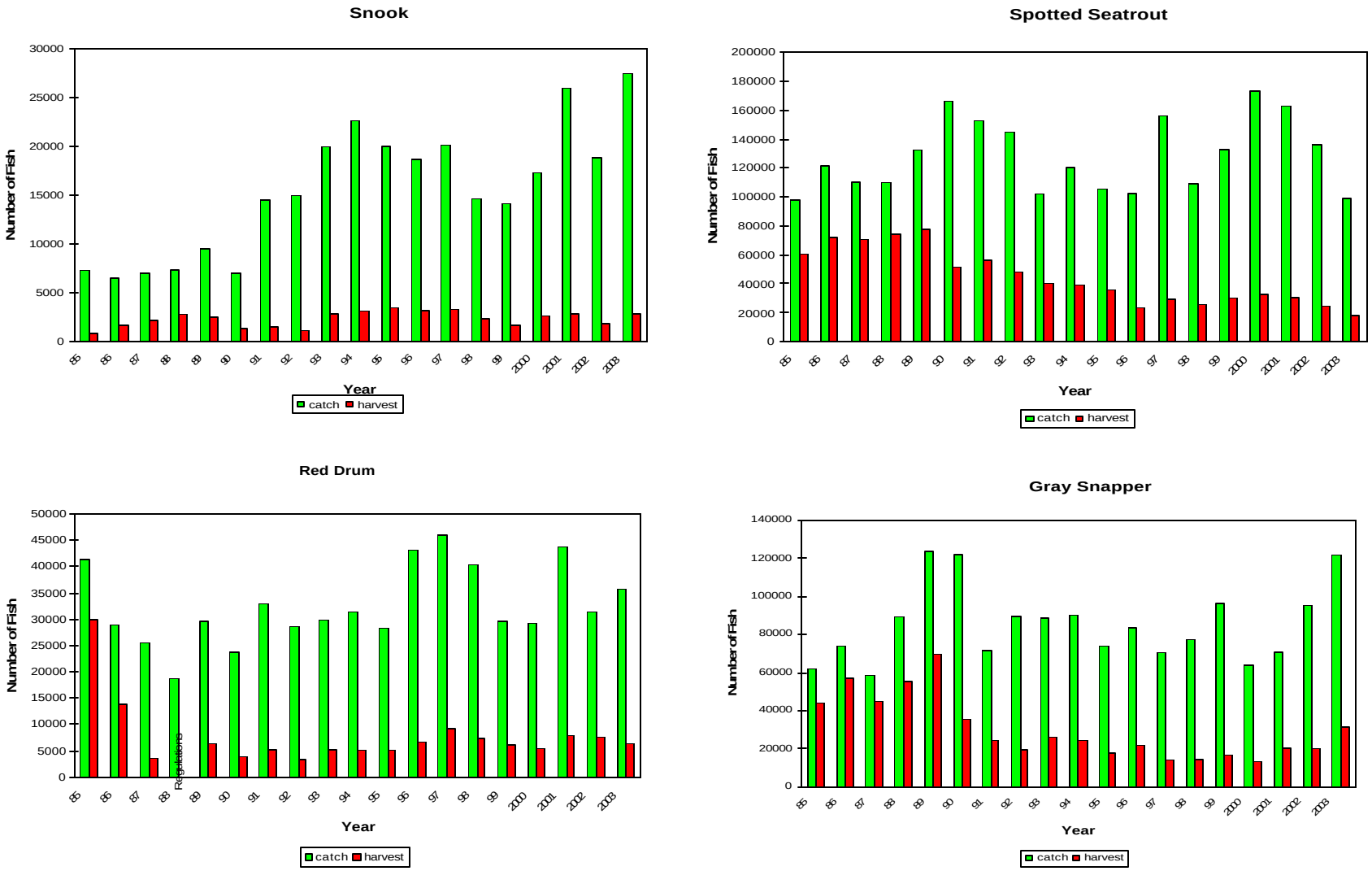


Figure 9. Estimated total catch and harvest for the four major species of gamefish by non-guided (sport) anglers in Florida Bay (Areas 1-5), 1985-2003.

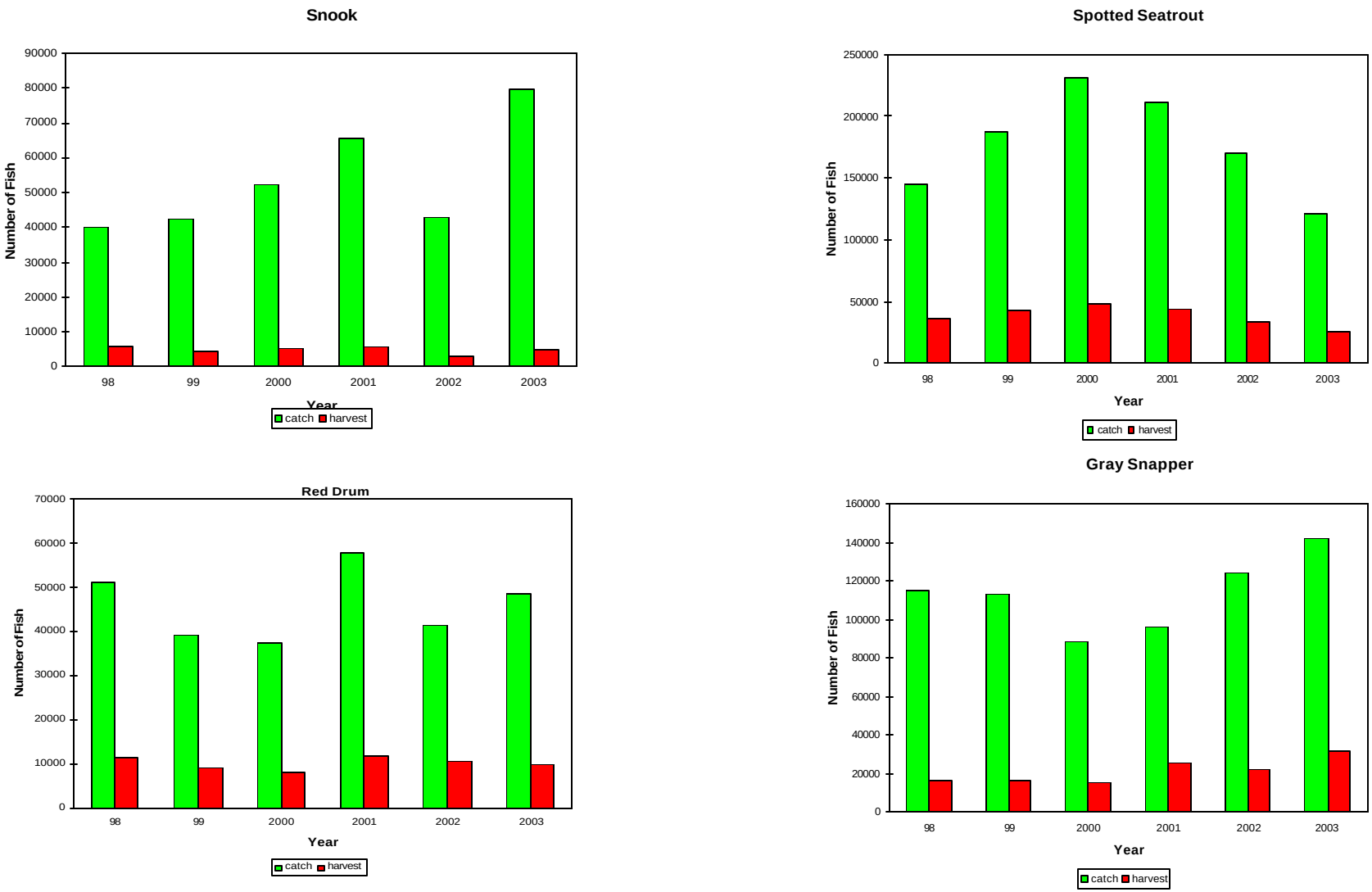


Figure 9a. Estimated total catch and harvest for the four major species of gamefish by non-guided (sport) anglers in Florida Bay and Everglades City (Areas 1-6), 1998-2003.

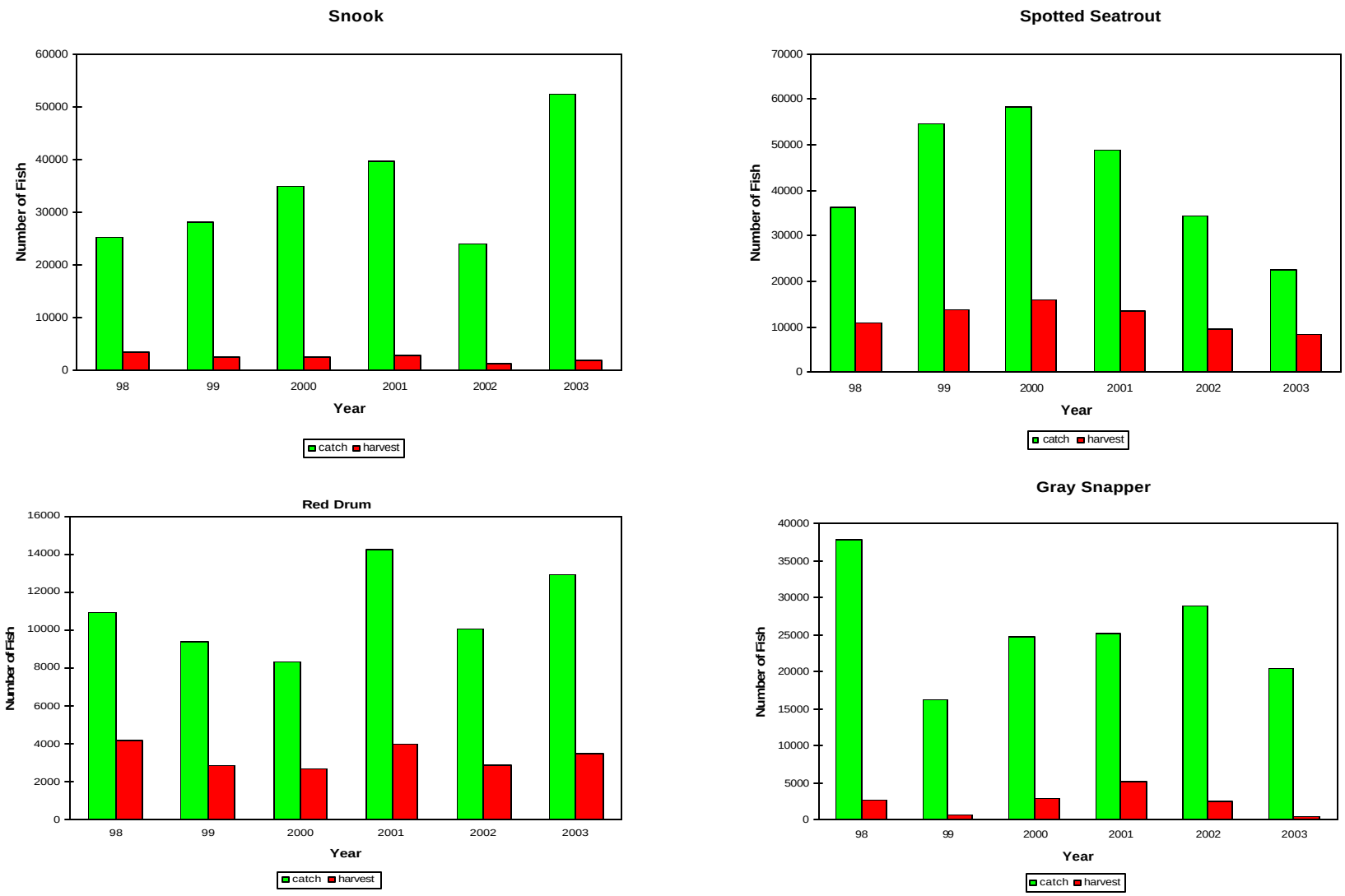


Figure 9b. Estimated total catch and harvest for the four major species of gamefish by non-guided (sport) anglers in Everglades City (Area 6), 1998-2003.

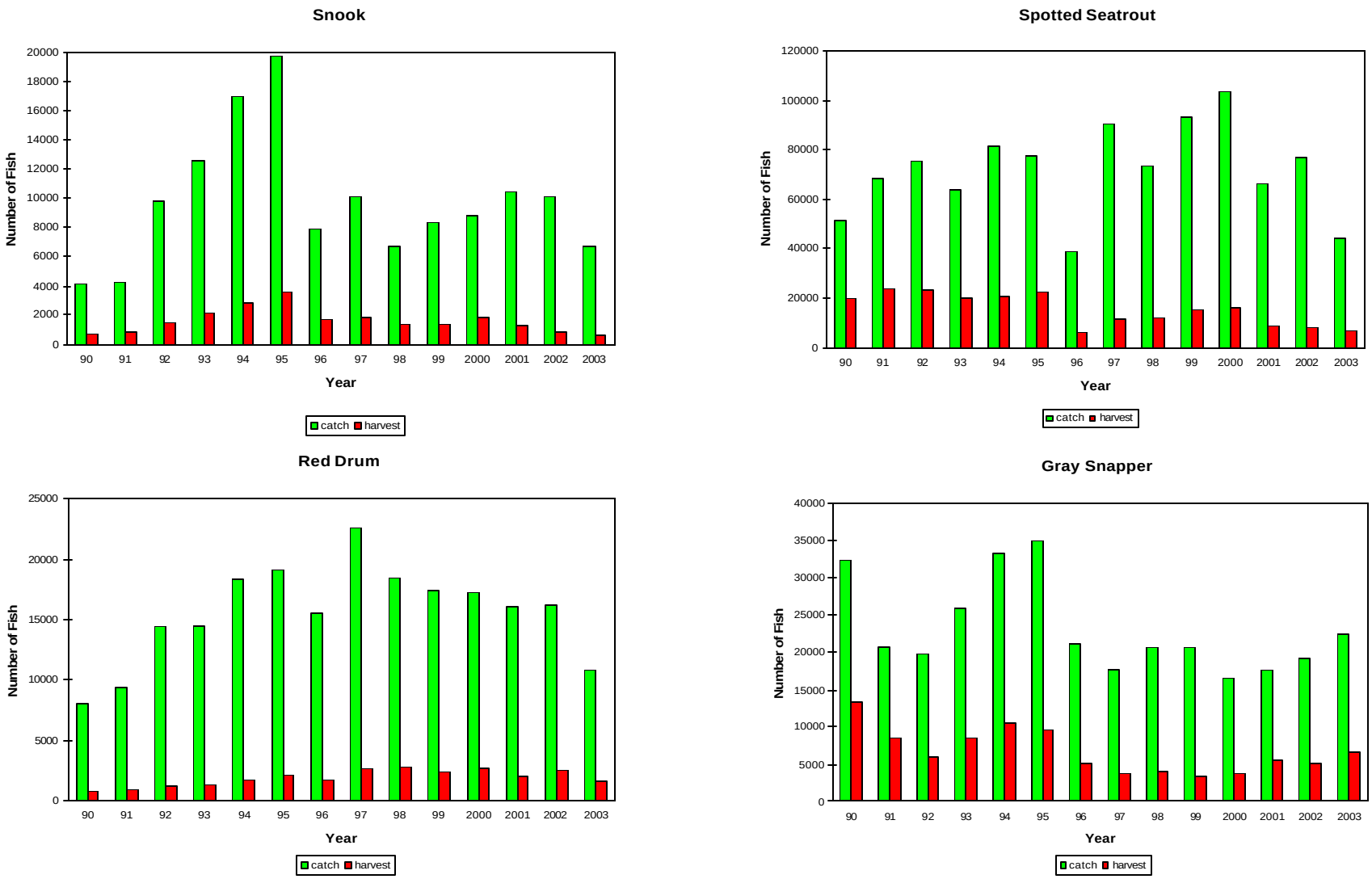
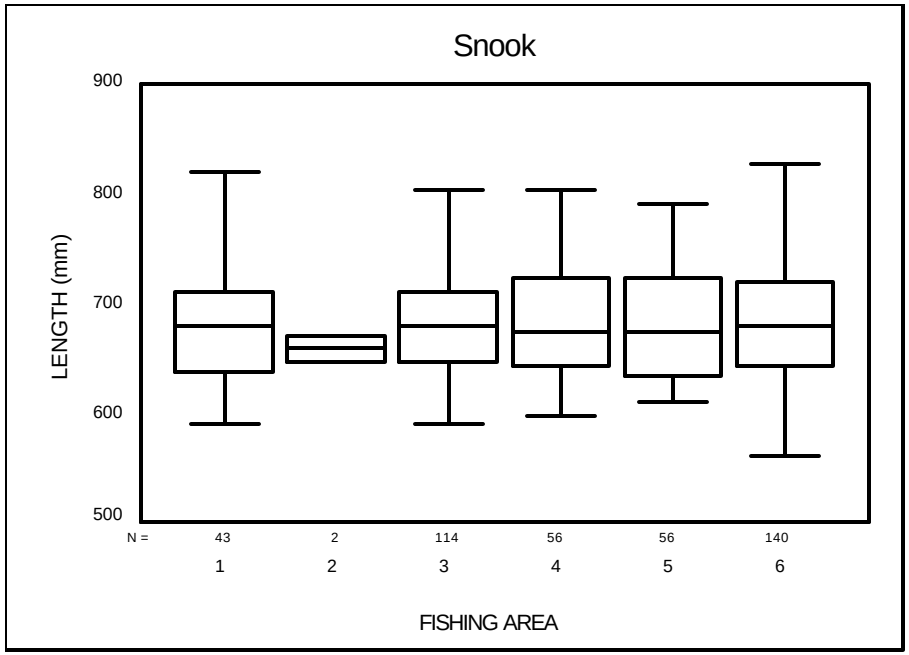
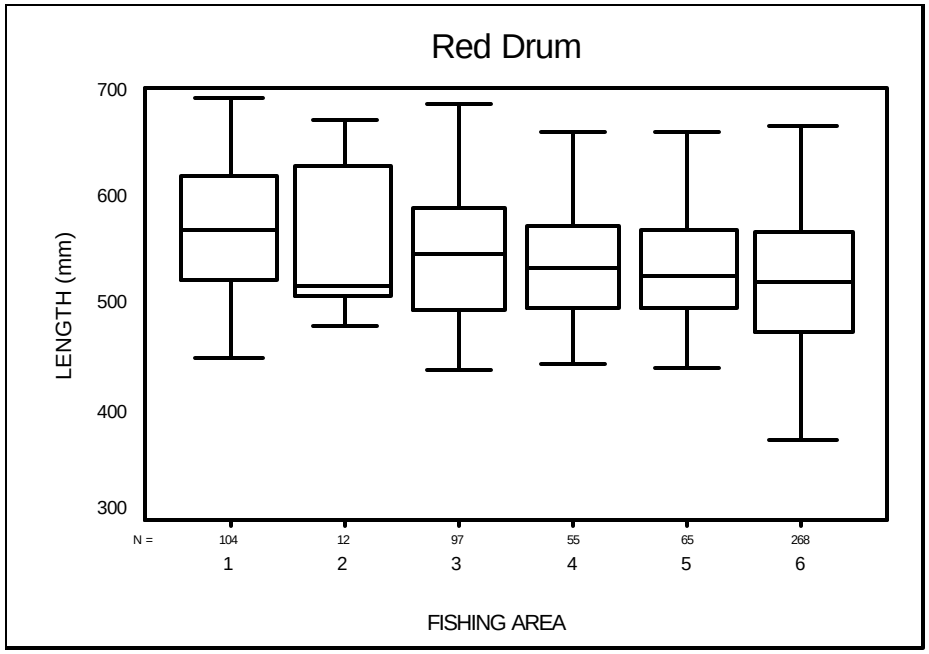
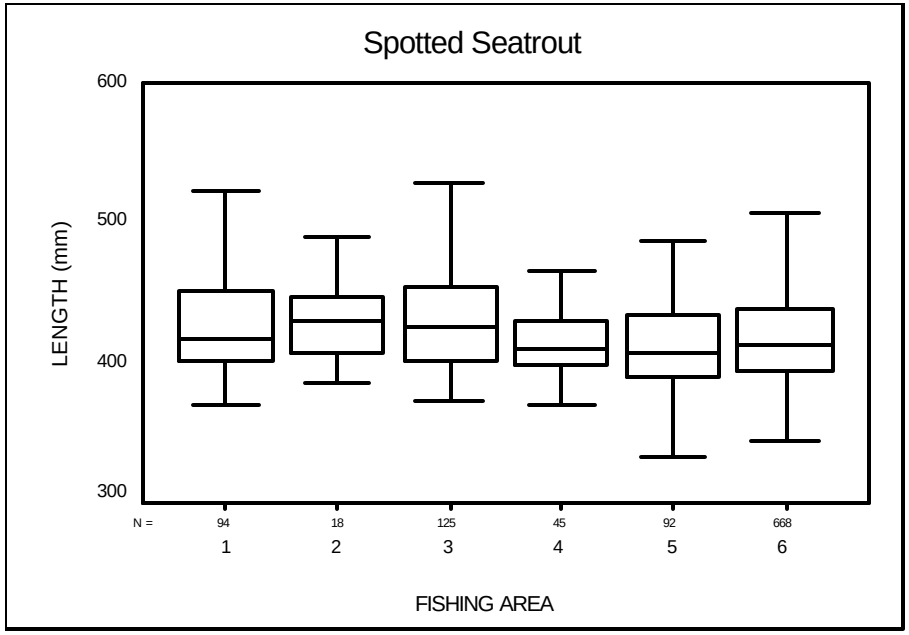


Figure 10. Estimated total catch and harvest of the four major species of gamefish by guided anglers in Florida Bay (Areas 1-5), 1990-2003.







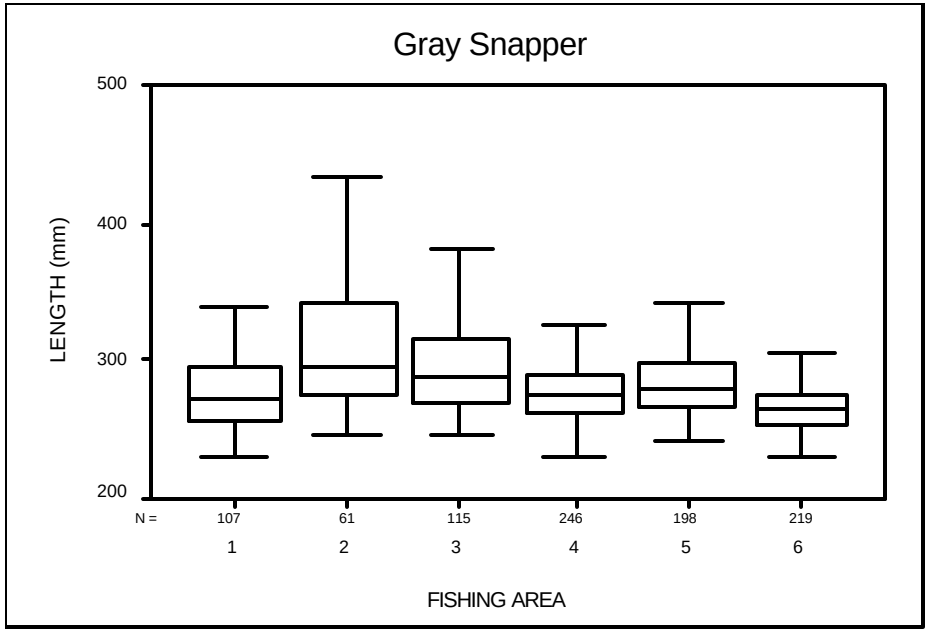
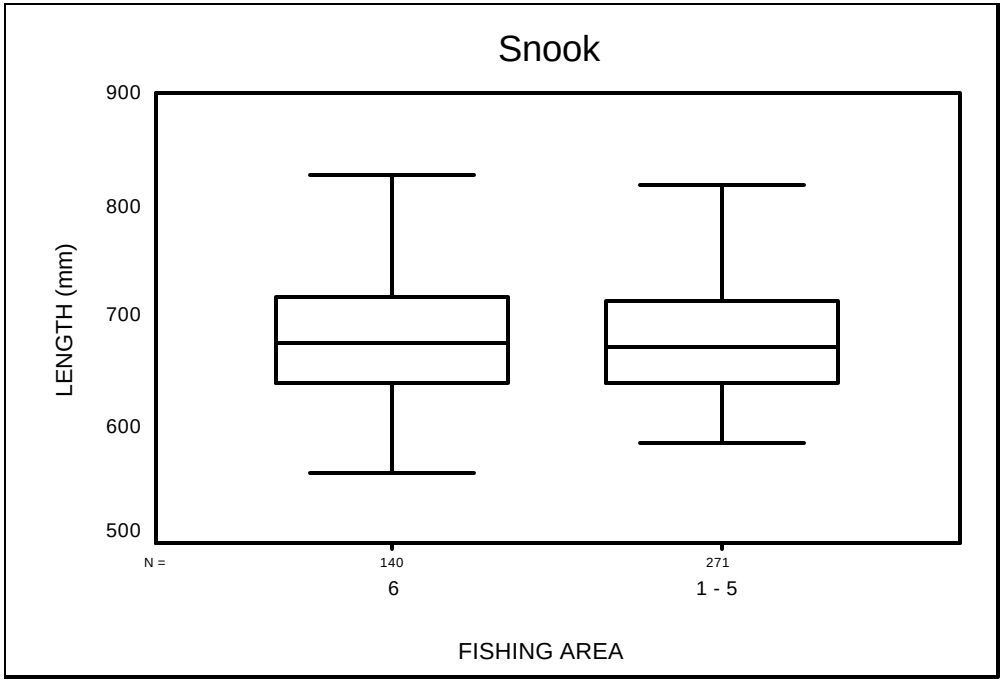
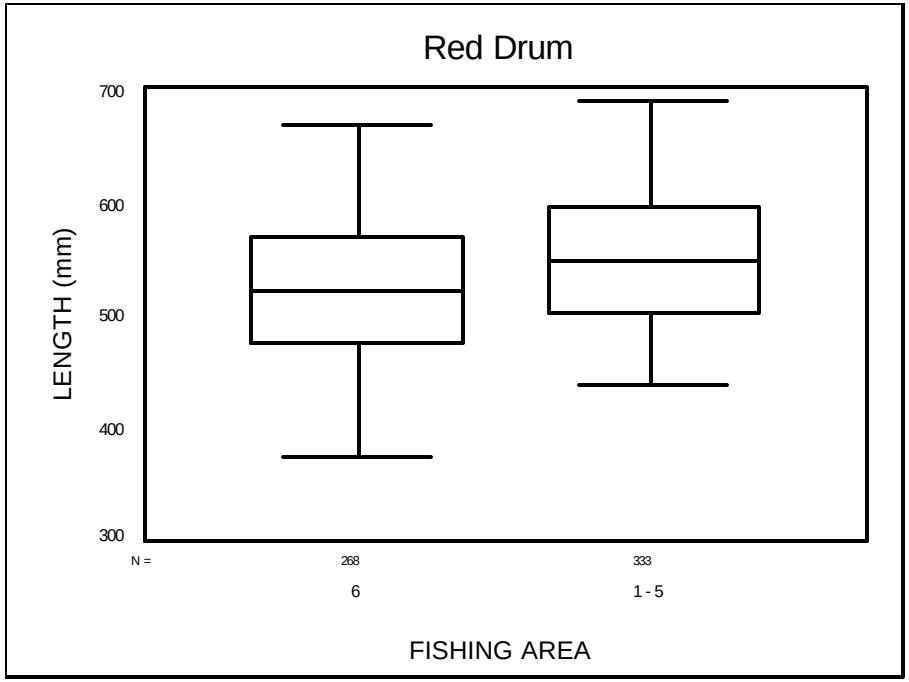
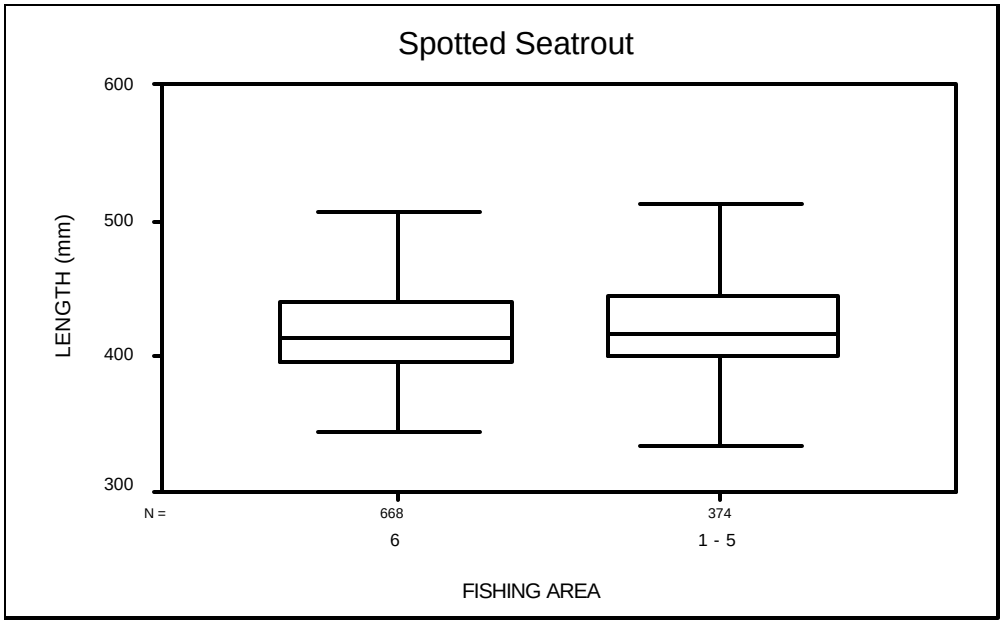


Figure 11. The lengths of the four major species of fish caught by recreational (non-guided) anglers in the six ecologically distinct fishing areas within Everglades National Park during 2003. The "box" represents the interquartile range; the horizontal line in the "box" represents the median; N represents the number of fish measured in each area.







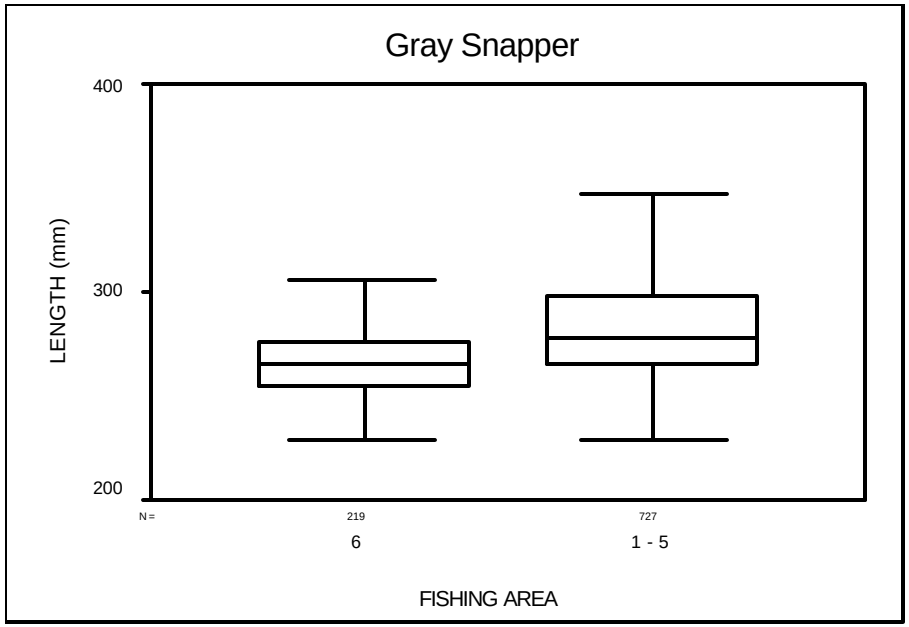
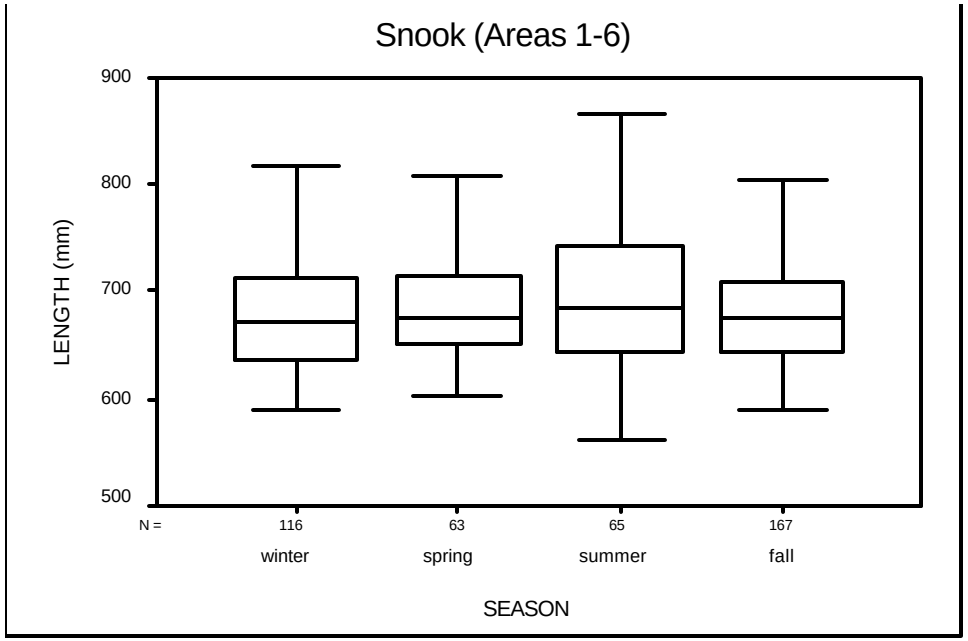
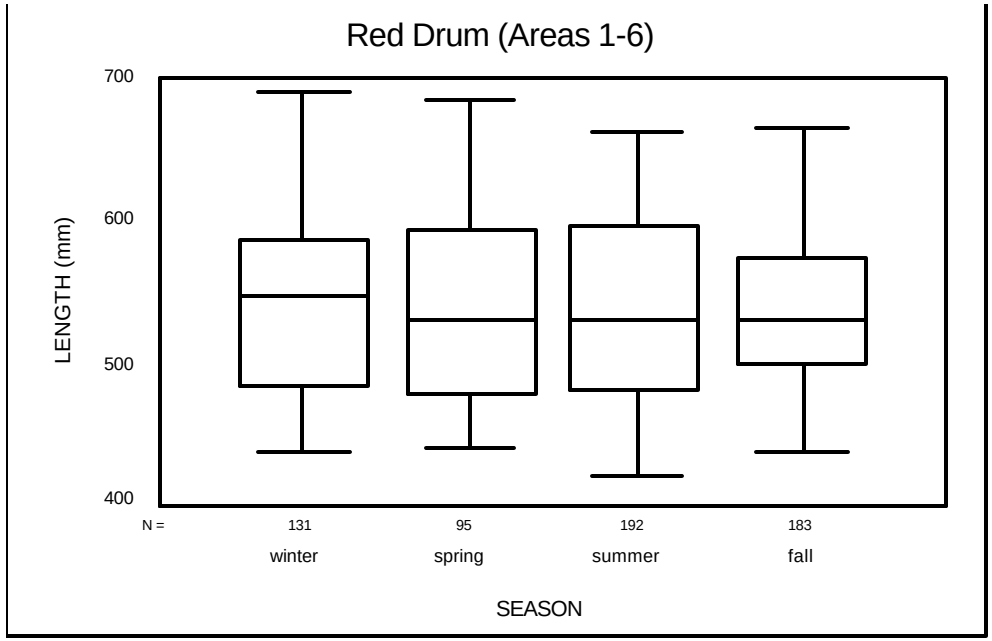
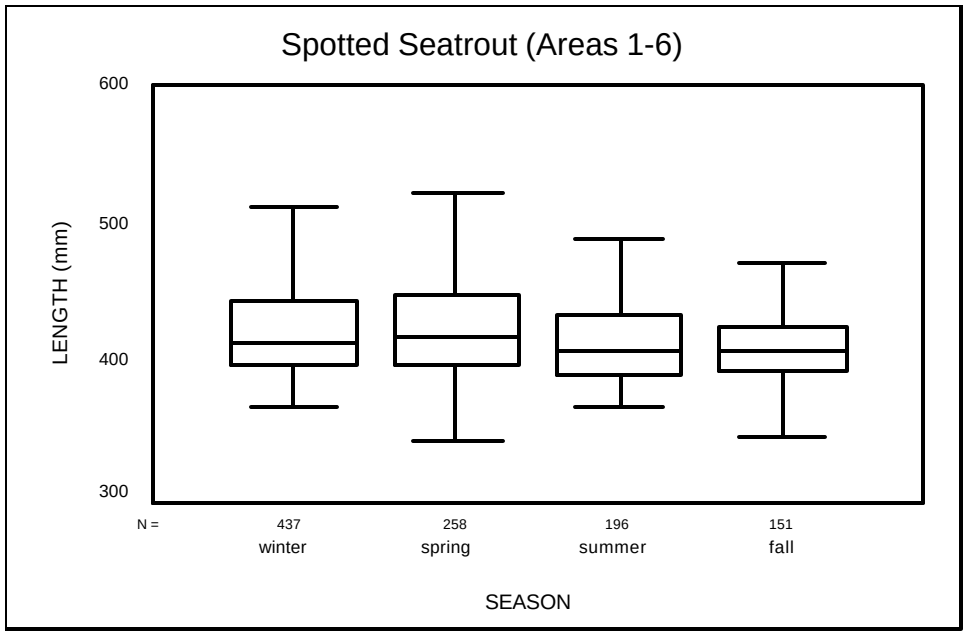


Figure 12. The lengths of the four major species of fish caught by recreational (non-guided) anglers in Florida Bay (Areas 1-5) and Everglades City (Area 6) within Everglades National Park during 2003. The "box" represents the interquartile range; the horizontal line in the "box" represents the median; N represents the number of fish measured in each area.







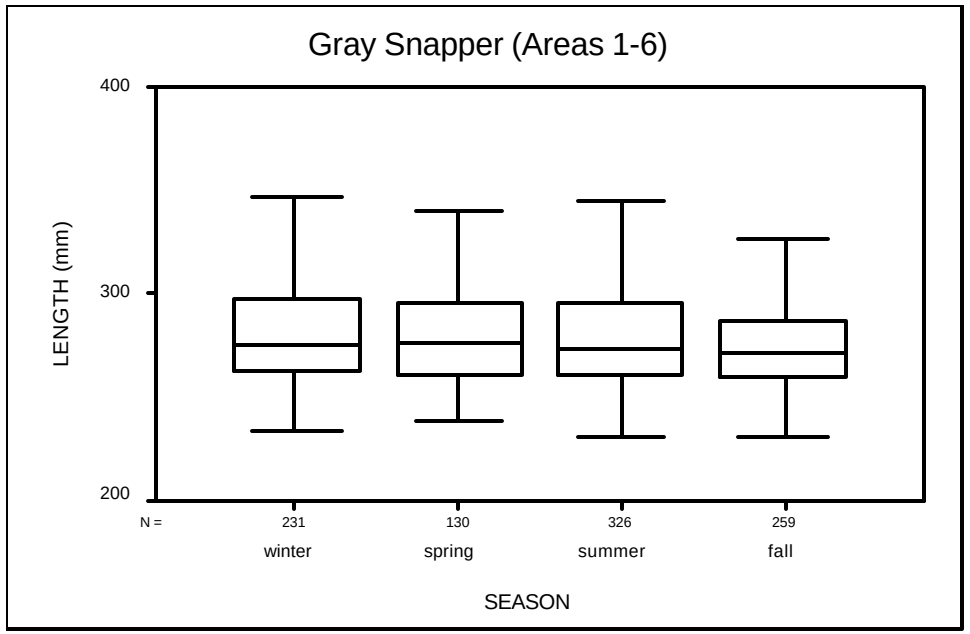
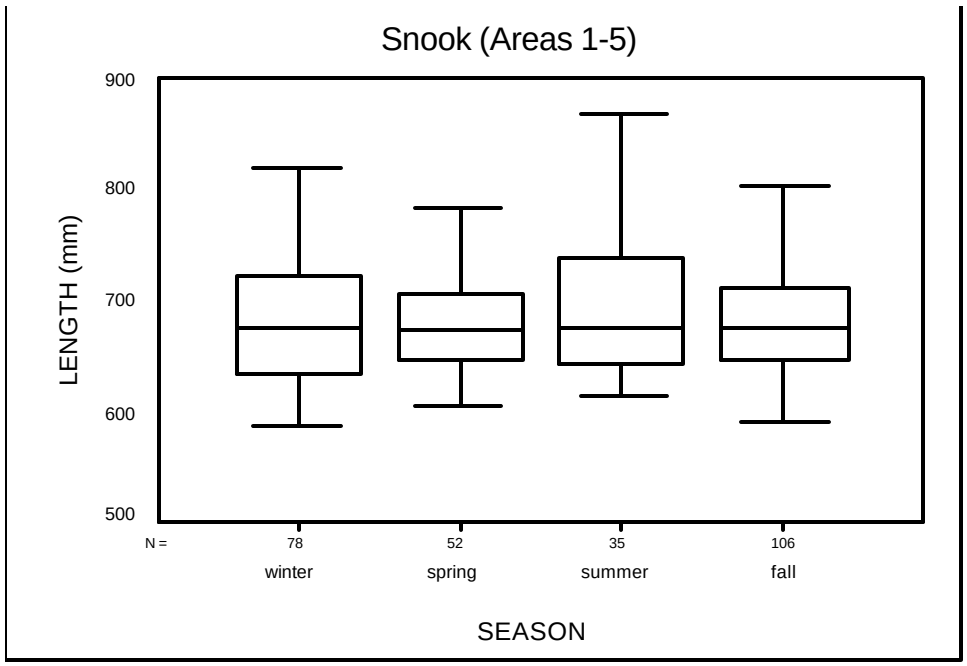
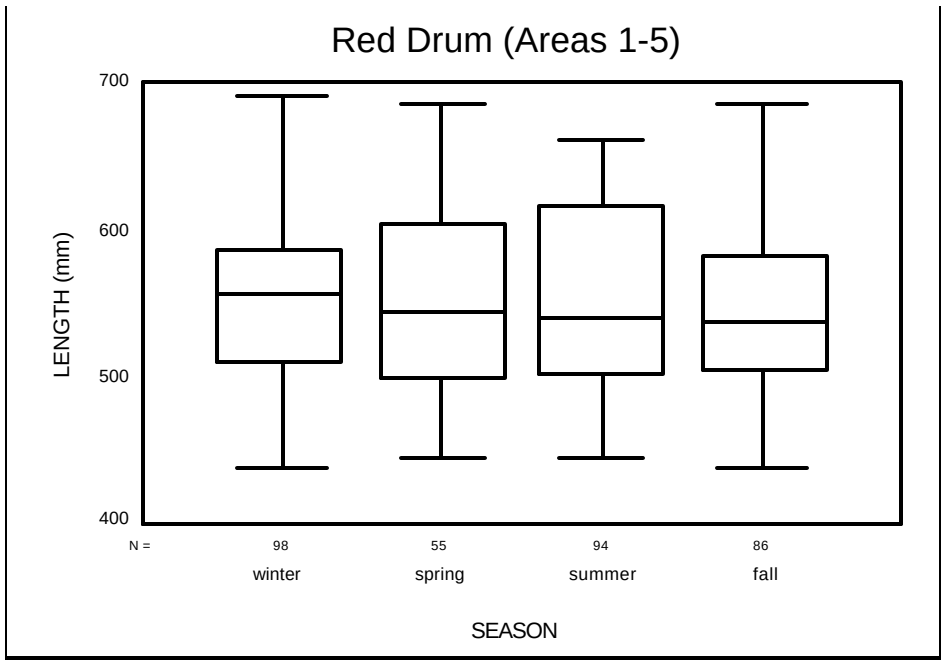
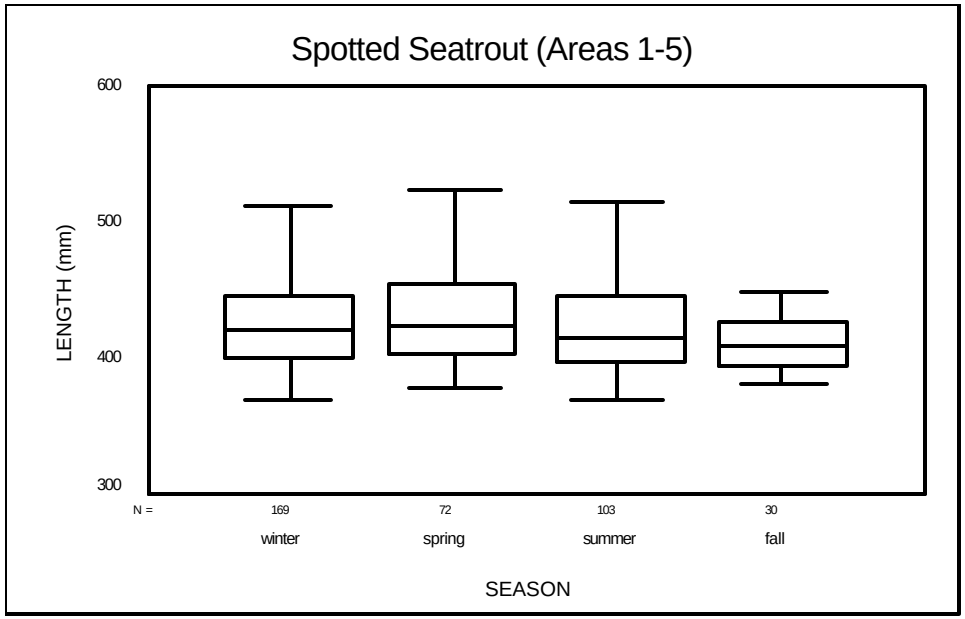


Figure 13. **The lengths of the four major species of fish caught by recreational (non-guided) anglers in Everglades National Park during the fall, spring, summer, and winter of 2003. The "box" represents the interquartile range; the horizontal line in the "box" represents the median; N represents the number of fish measured in each area; Winter = January-March, Spring = April-June, Summer = July-September, and Fall = October-December.**







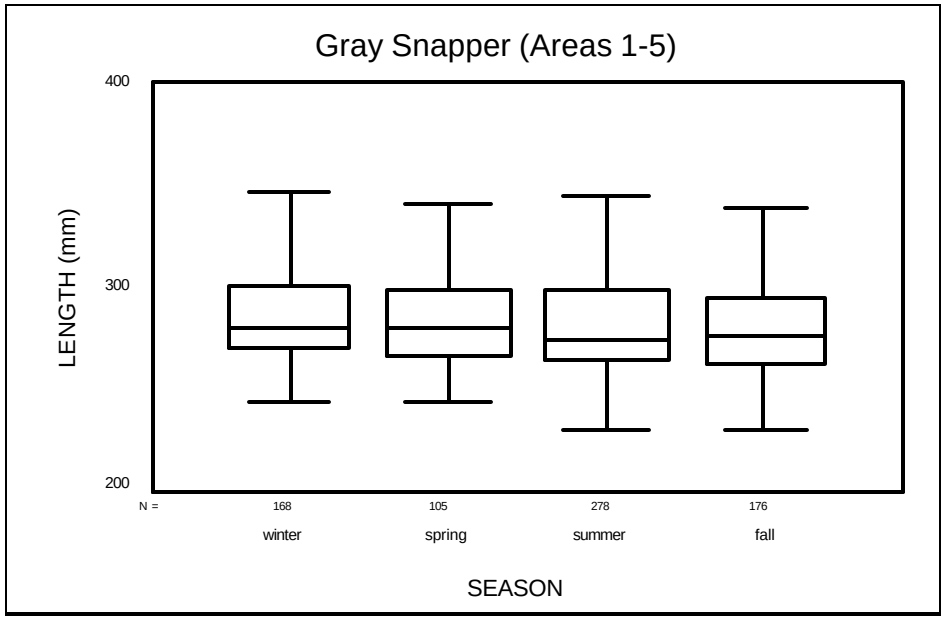
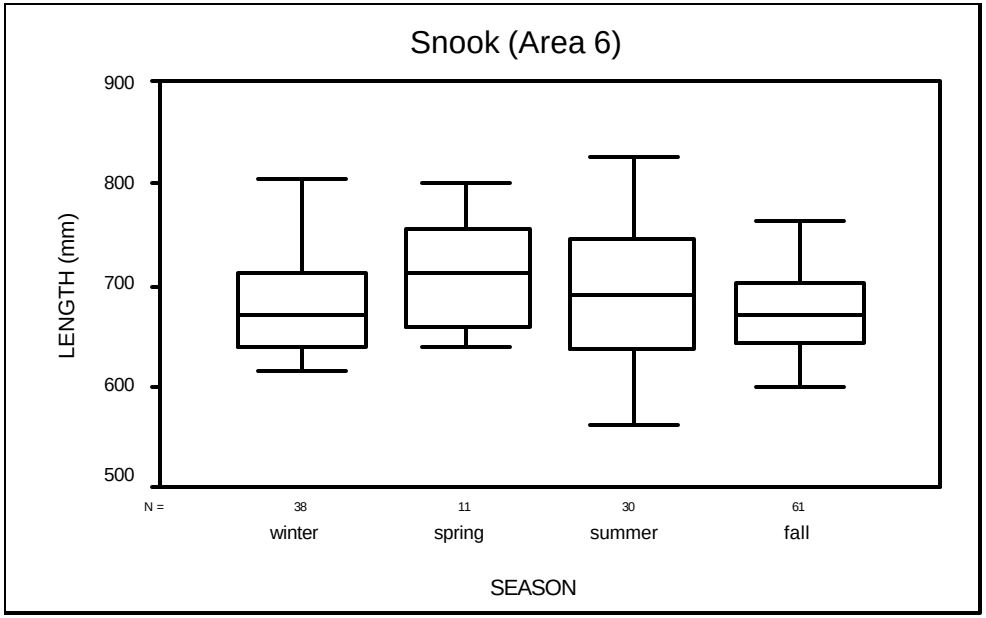
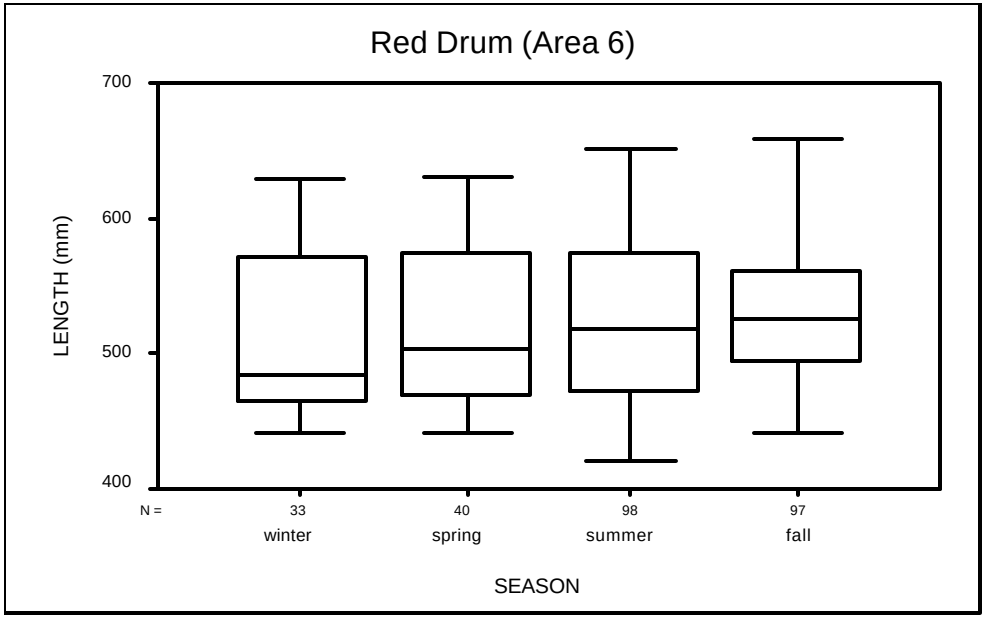
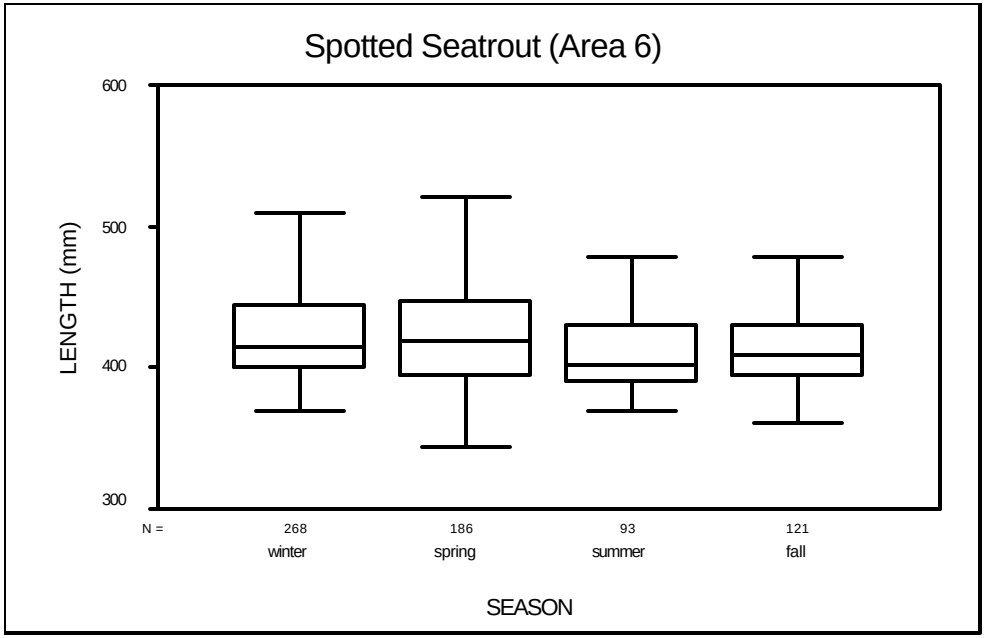


Figure 14. The lengths of the four major species of fish caught by recreational (non-guided) anglers in Florida Bay (Areas 1-5) during the fall, spring, summer, and winter of 2003. The "box" represents the interquartile range; the horizontal line in the "box" represents the median; N represents the number of fish measured in each area; Winter = January-March, Spring = April-June, Summer = July-September, and Fall = October-December.







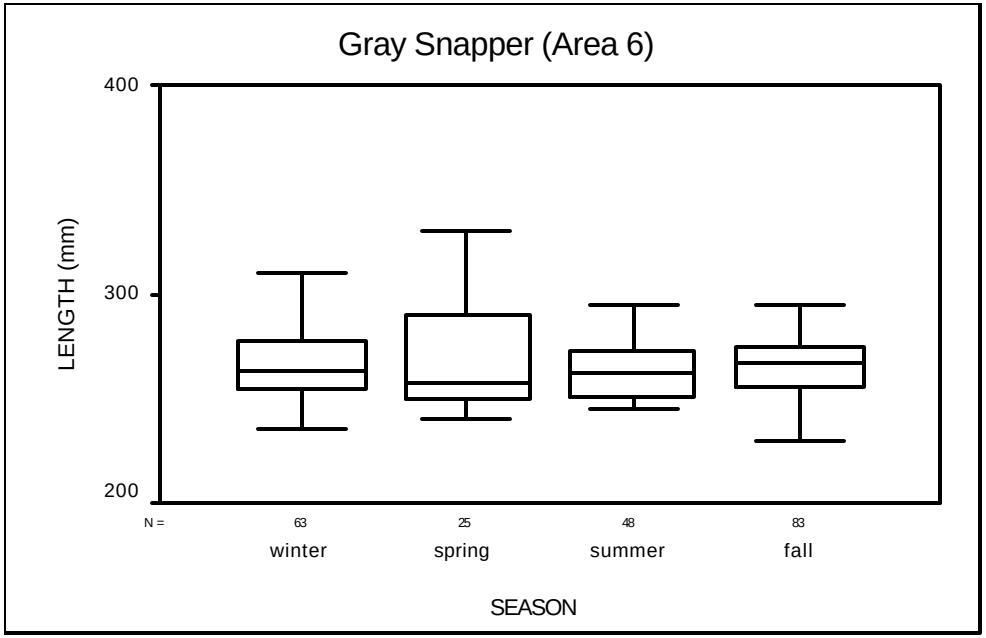


Figure 15. The lengths of the four major species of fish caught by recreational (non-guided) anglers in Everglades City (Area 6) during the fall, spring, summer, and winter of 2003. The "box" represents the interquartile range; the horizontal line in the "box" represents the median; N represents the number of fish measured in each area; Winter = January-March, Spring = April-June, Summer = July-September, and Fall = October-December.

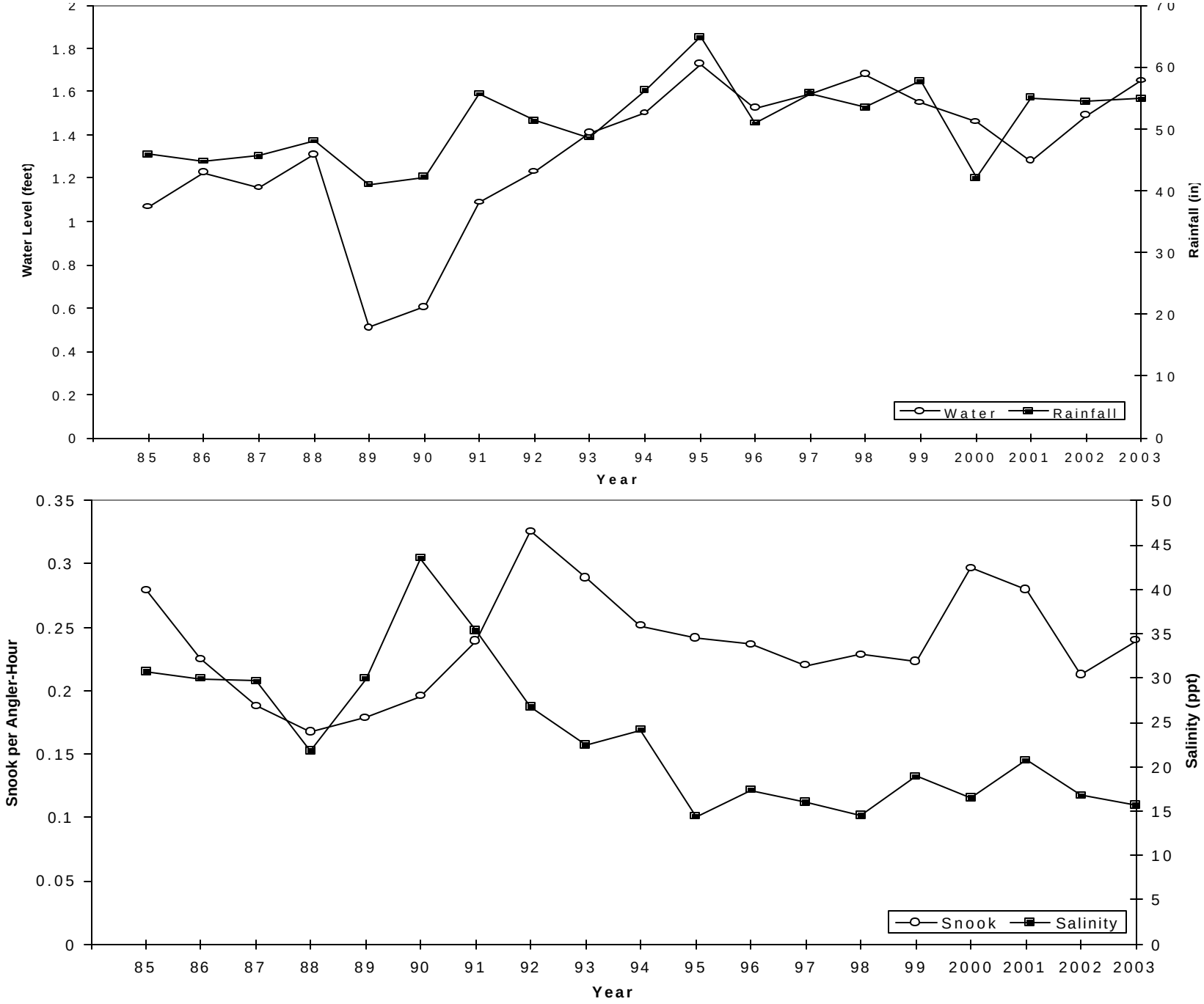
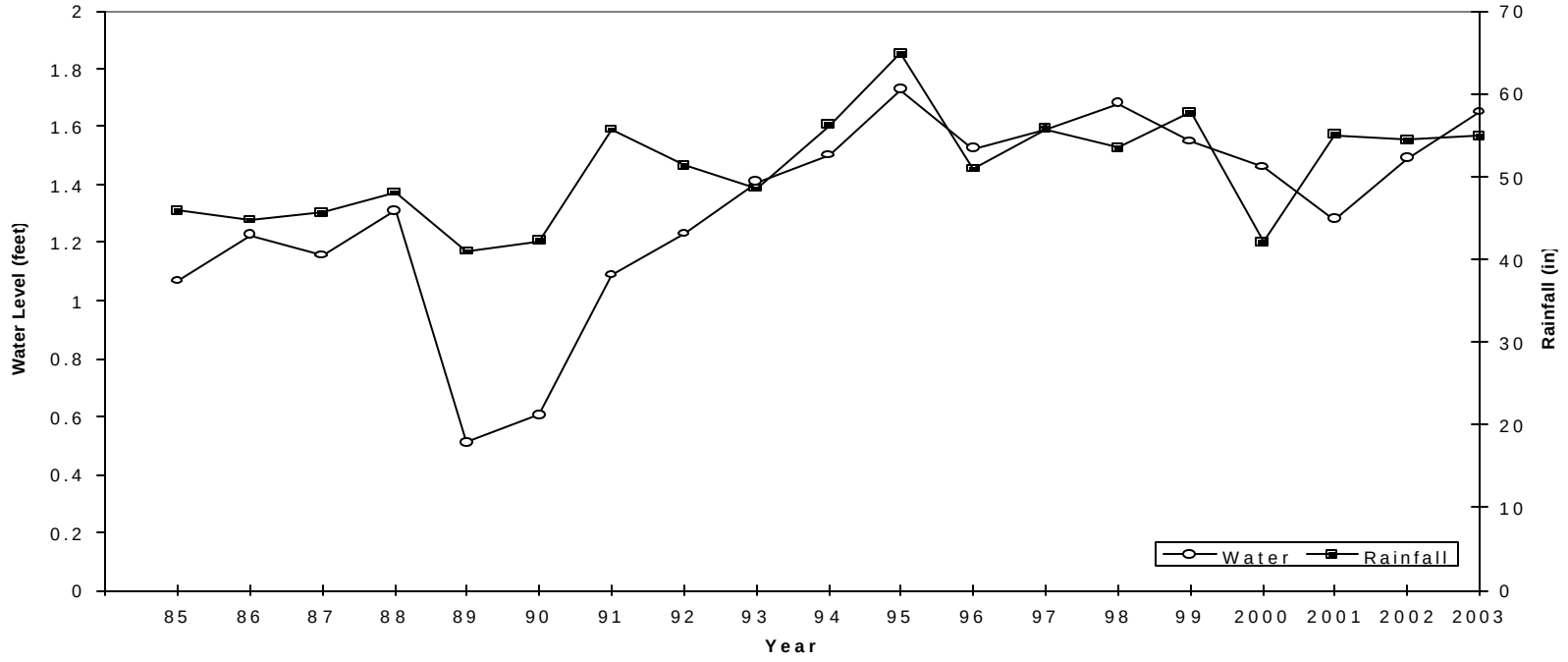


Figure 16. Average rainfall recorded at 5 stations in or near ENP, average water level at P-37 in Taylor Slough, average salinity at 2 stations in northern Florida Bay, and non-guide catch rates of Snook in Florida Bay (Areas 1-5) from 1985 to 2003.



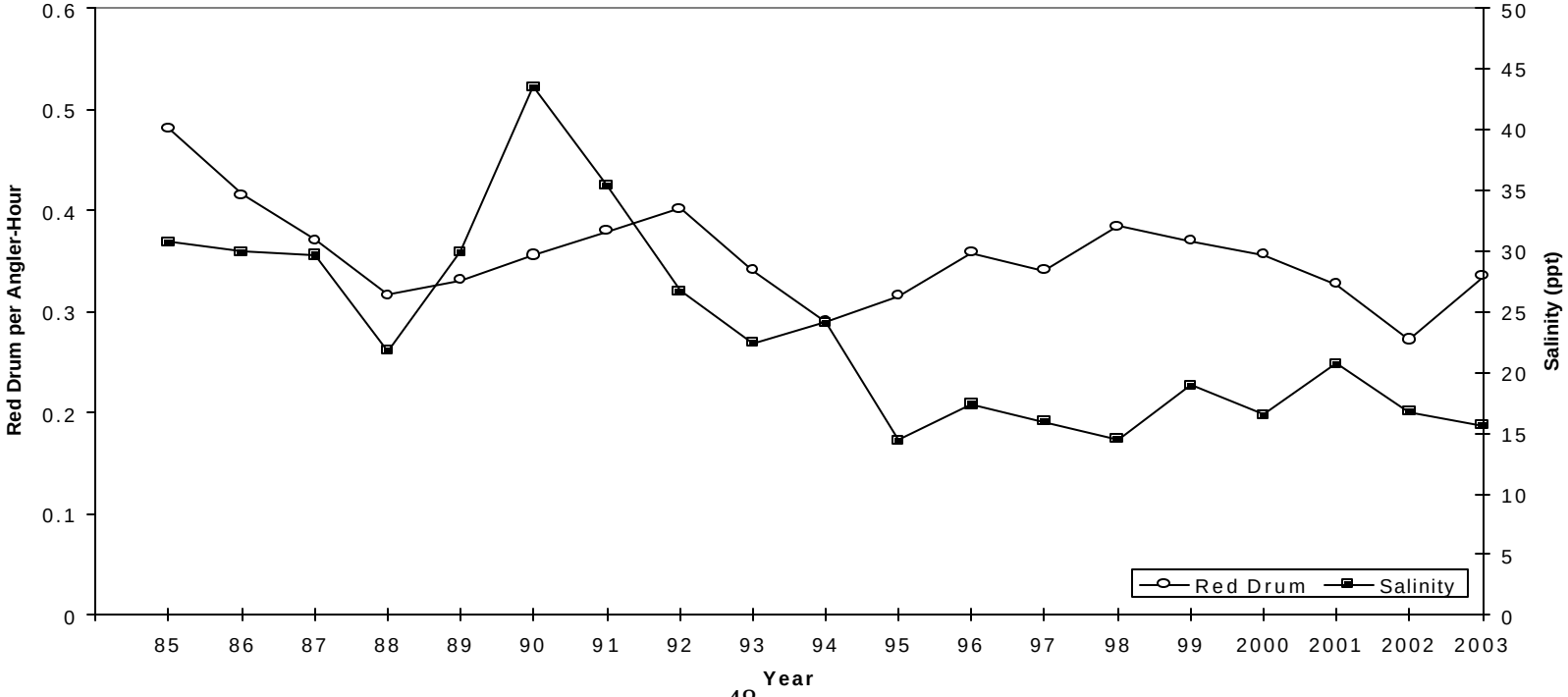


Figure 17. Average rainfall recorded at 5 stations in or near ENP, average water level at P-37 in Taylor Slough, average salinity at 2 stations in northern Florida Bay, and non-guide catch rates of Red Drum in Florida Bay (Areas 1-5) from 1985 to 2003.

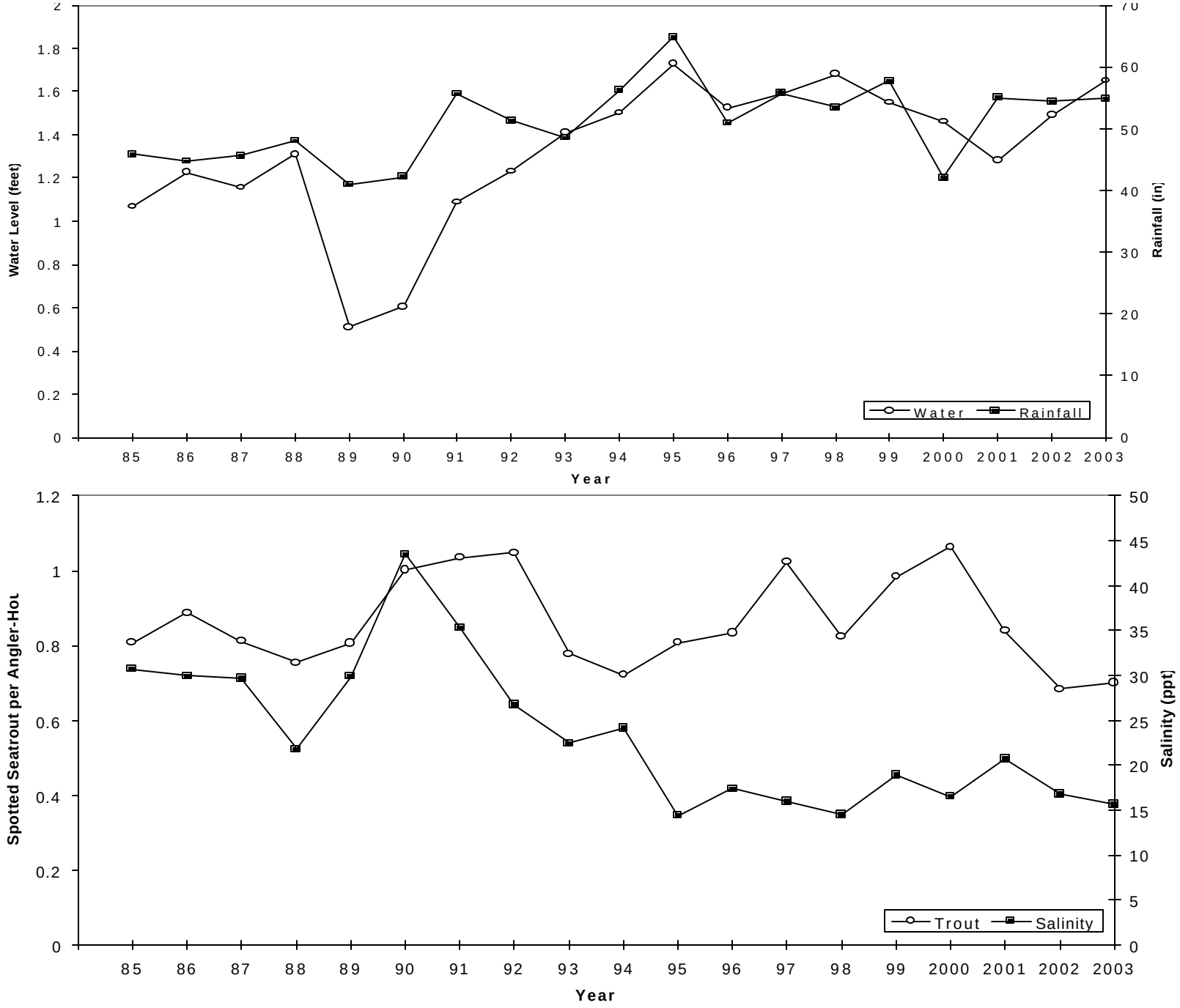


Figure 18. Average rainfall recorded at 5 stations in or near ENP, average water level at P-37 in Taylor Slough, average salinity at 2 stations in northern Florida Bay, and non-guide catch rates of Trout in Florida Bay (Areas 1-5) from 1985 to 2003.

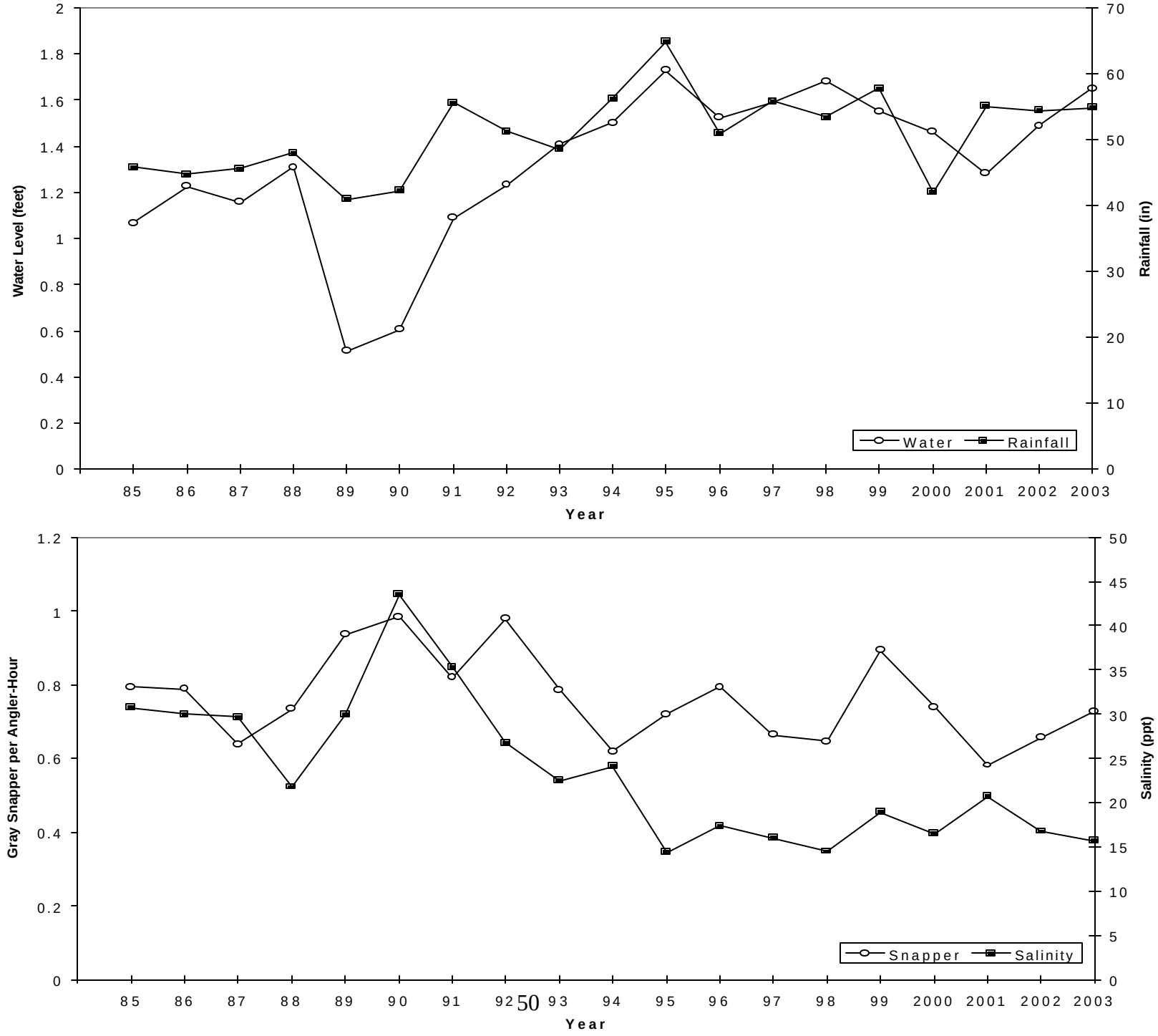


Figure 19. Average rainfall recorded at 5 stations in or near ENP, average water level at P-37 in Taylor Slough, average salinity at 2 stations in northern Florida Bay, and non-guide catch rates of Snapper in Florida Bay (Areas 1-5) from 1985 to 2003.

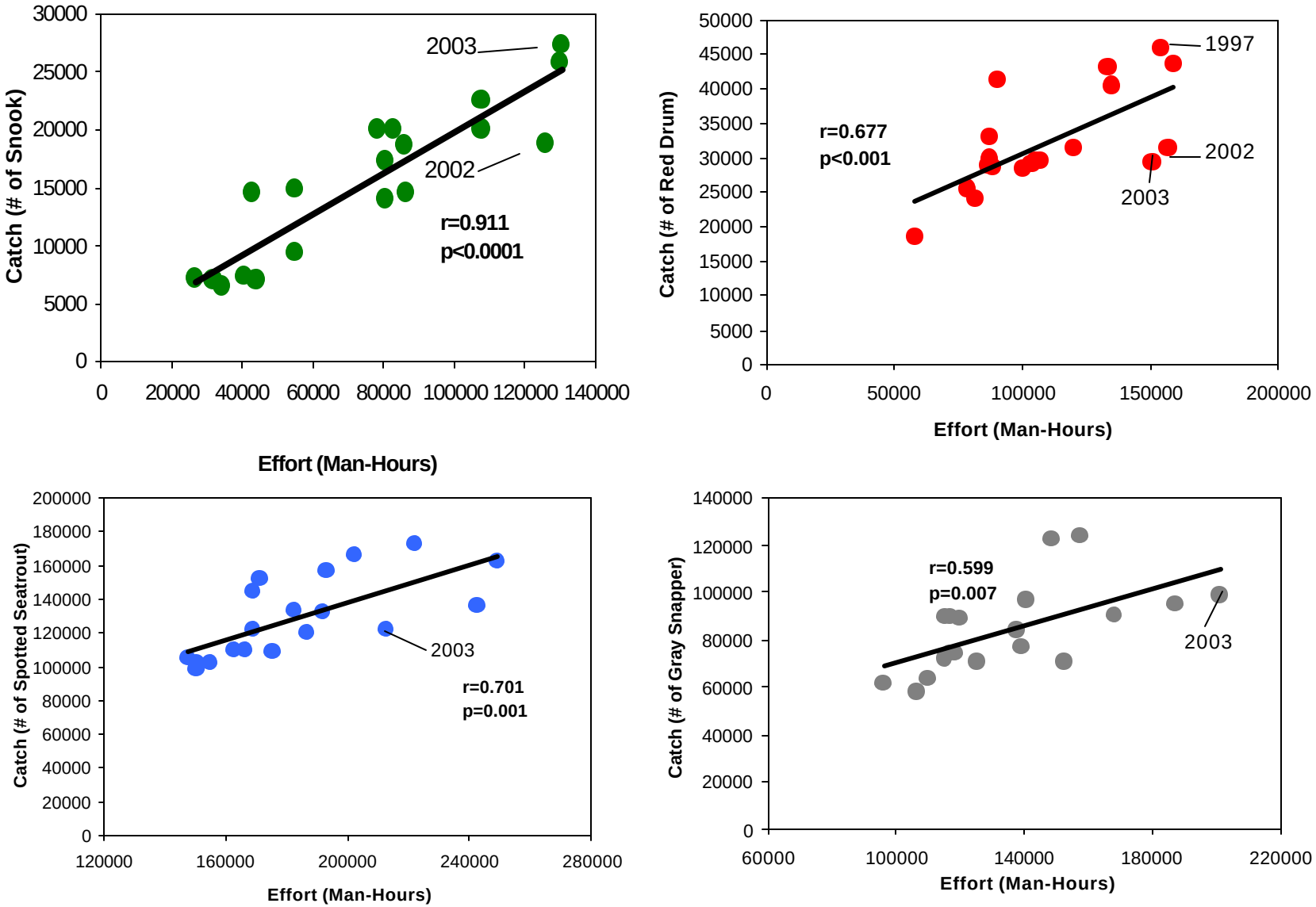


Figure 20. Correlation of total estimated catch and total estimated effort of non-guided (recreational) anglers for snook, red drum, spotted seatrout, and gray snapper in Florida Bay (Areas 1-5), 1985-